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Development and Clinical Efficacy Study of a New Type of Elastic Compression Palatal Splint

Junli Zhu, Shuo Zhang, Jing Wang

Yulin Hospital, The First Affiliated Hospital of Xi'an Jiaotong University, Xi'an 719000, Shaanxi, China

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Abstract: *Objective*: To investigate the clinical efficacy of a novel elastic compression palatal splint, independently developed by our team, following the surgical resection of palatal cysts and benign tumors. *Methods*: A total of 90 patients who underwent surgery for benign palatal lesions at the Department of Oral and Maxillofacial Surgery of our hospital between January 2023 and December 2025 were selected as study subjects. Using a random number table, they were divided into three groups, A, B, and C, with 30 patients in each group. Group A underwent postoperative compression fixation using a purse-string suture with iodoform gauze; Group B used a conventional rigid palatal splint for compression fixation; and Group C received postoperative intervention with the newly developed elastic compression palatal splint. Patients were followed up to observe their postoperative recovery, and comparisons were made across the three groups regarding the incidence of dental damage, wound infection rates, wound healing times, and postoperative comfort scores. *Results*: The incidence of dental trauma and wound infection in Group C was significantly lower than in Groups A and B; wound healing time in Group C was markedly shorter than in Groups A and B; and the visual analog scale (VAS) comfort scores for postoperative wear in Group C were significantly better than in the other two groups. The differences in data comparisons between the groups were all statistically significant ($p < 0.05$). *Conclusion*: The novel elastic compression palatal splint enables uniform elastic compression of the postoperative palatal wound, provides visual and adjustable pressure, and facilitates unobstructed drainage of wound exudate. It effectively mitigates the drawbacks of traditional surgical procedures, significantly reduces the incidence of postoperative complications, shortens the wound healing period, and improves the patient's postoperative wearing experience. The structural design of this splint meets the clinical requirements for precision treatment; it is simple to use, highly safe, and widely applicable. It aligns with the trend towards precision medicine in dentistry and possesses significant value for clinical promotion and application.

Keywords: Palatal surgery; Palatal splint; Elastic compression; Pressure regulation; Wound healing; Clinical efficacy

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1. Introduction

Benign space-occupying lesions of the palate are common and frequently occurring conditions in oral and

maxillofacial surgery. In recent years, influenced by multiple factors, including changes in dietary patterns, alterations in oral hygiene practices, and the widespread screening for oral diseases, the clinical detection rate and surgical treatment volume for benign space-occupying lesions of the palate have shown a year-on-year increase. Excision of benign palatal lesions is the core surgical procedure for the radical treatment of this condition. Although the operation can completely remove the lesion and prevent recurrence, it results in an open palatal wound post-operatively [1]. As the palatal wound is directly exposed to the oral environment, it is subject to prolonged contact with contaminants such as saliva, the oral microbiota, and food debris. Furthermore, routine oral activities such as chewing, swallowing, and speaking exert continuous traction on the wound, resulting in a hostile healing environment that is highly prone to complications such as wound bleeding, infection, delayed healing, and mucosal scar hyperplasia. Consequently, effective hemostasis, precise compression, sealed protection, and drainage of exudate from the postoperative wound are key factors in ensuring surgical efficacy, promoting wound healing, and improving patient prognosis [2,3]. Currently, the two main methods of pressure management for postoperative palatal wounds in domestic clinical practice are the purse-string suture fixation of iodoform gauze and the traditional rigid palatal splint fixation; however, long-term clinical application has demonstrated that both methods have significant structural defects and therapeutic limitations. The purse-string suture technique relies on the patient's natural dentition as the sole point of force application; by using circular sutures to pull and secure the dressing, it generates continuous palatal traction during the compression process, which is highly likely to lead to tooth mobility, palatal displacement, periodontal ligament damage, and may even result in irreversible dental damage; Furthermore, as the sutures form a rigid fixation structure, they cannot adapt to the dynamic changes in post-operative tissue oedema and reabsorption. Tension in the sutures gradually diminishes due to traction from routine oral movements, which can lead to issues such as dressing dislodgement and failure of compression. This makes it difficult to maintain stable pressure on the wound site, failing to meet the clinical treatment requirements of modern oral surgery for precise compression, dynamic adaptation, safe minimally invasive procedures, and controlled healing. Consequently, there are numerous problems, including a high incidence of complications, unstable healing outcomes, and poor patient comfort [4]. To overcome the technical bottlenecks of existing methods and address the clinical challenges in the treatment of post-operative palatal wounds, our research team has independently developed a novel elastic compression palatal splint. This device integrates four core functions: elastic adaptive fitting, micro-pressure monitoring, dynamic pressure regulation, and wound-specific drainage. To validate the clinical advantages of this new device, we have designed three groups of clinical controlled trials, systematically comparing the clinical efficacy of the new palatal splint with that of conventional surgical procedures, with the aim of providing novel, safe, and efficient instrumental support and clinical evidence for the standardized and precise treatment of post-operative palatal wounds.

2. Materials and methods

2.1. General data

A total of 90 patients who underwent resection of benign palatal lesions at the Department of Oral and Maxillofacial Surgery of our hospital between January 2023 and December 2025 were selected as study subjects. All patients were diagnosed with benign palatal lesions based on preoperative imaging and postoperative histopathological examinations. Using a random number table, all patients were divided into three groups, A, B, and C, with 30 patients in each group. The study protocol was reviewed and approved

by our hospital's Medical Ethics Committee, and the research process strictly adhered to medical ethical principles. Comparison of baseline data, including age, sex, lesion type, wound area, and duration of surgery, among the three groups revealed no statistically significant differences ($p > 0.05$), indicating that the groups were comparable.

2.1.1. Inclusion criteria

(1) Patients undergoing their first surgical resection of a benign palatal lesion;
(2) The lesion was located on the hard palate or at the junction of the hard and soft palates;
(3) Postoperative compression dressing with iodoform gauze was required;
(4) Patients demonstrated good compliance and were able to complete the full course of follow-up

2.1.2. Exclusion criteria

(1) Patients with concomitant diabetes, immunodeficiency, or long-term corticosteroid use;
(2) Patients with preoperative oral infections;
(3) Patients with extensive penetrating defects of the palate;
(4) Patients with incomplete clinical data

2.2. Methods

All patients underwent surgery performed by the same team of senior oral and maxillofacial surgeons at our hospital. Surgical procedures followed standardized protocols, involving thorough debridement of the lesion and hemostasis during surgery. Postoperatively, all patients received standard interventions including routine antimicrobial therapy, oral hygiene care, and dietary guidance.

Group A received compression fixation using a purse-string suture with iodoform gauze. Postoperatively, sterile iodoform gauze was cut to size according to the wound dimensions and applied smoothly over the palatal wound. Circular purse-string sutures were placed along the natural dentition surrounding the wound; the sutures were passed around the cervical region of the teeth and tightened to ensure the iodoform gauze adhered closely to the wound surface. Pressure was applied via the tension of the sutures to achieve hemostasis and fixation. Following ligation, the fit of the dressing was checked to ensure there was no looseness or displacement. The sutures were removed 7 days postoperatively, and the wound healing was assessed; routine oral care and follow-up were carried out.

Group B was treated with a traditional rigid palatal splint for compression and fixation. An oral impression was taken one week prior to surgery, and a one-piece traditional rigid palatal splint was fabricated using hard acrylic resin; the edges were ground and polished to conform to the patient's palatal anatomy. Following hemostasis and coverage of the wound with iodine-impregnated gauze at the conclusion of surgery, the pre-fabricated rigid palatal splint was fitted. The compressive force exerted by the splint's rigid structure was utilized to secure the dressing and apply pressure to the wound. The fit of the splint was assessed daily, with adjustments made to the tightness as required; the splint was cleaned regularly and worn continuously until the wound had achieved initial healing.

Group C was treated with a novel elastic compression palatal splint for compression fixation: this utilized a new type of elastic compression palatal splint independently developed by our research team. The core structure of the device comprises four major modules: a medical-grade, highly elastic silicone conforming body, a micro-pressure monitoring module, an adjustable helical compression assembly, and

longitudinal drainage grooves for the wound surface.

(1) The elastic conforming body is made of medical-grade, highly elastic silicone, which adapts to the curvature of the palate, offering excellent fit, high biocompatibility and no irritation;

(2) Micro-pressure monitoring module

Equipped with a high-precision pressure sensor that displays real-time pressure readings on the wound, enabling pressure visualization;

(3) Adjustable compression assembly

Utilizes a micro-screw adjustment mechanism to fine-tune the compression intensity according to the wound's healing progress;

(4) Drainage channels

Longitudinal drainage channels run through the inner side of the splint, allowing for the timely drainage of wound exudate and haematoma.

After hemostasis of the surgical wound and application of a sterile iodine dressing, the novel elastic pressure-applied palatal splint is fitted, the pressure monitoring module is calibrated, and the initial post-operative pressure value is recorded. Dynamic pressure adjustment is implemented according to the different stages of wound healing: during the peak period of tissue oedema (1–3 days post-operatively), the pressure is moderately reduced to avoid excessive local compression that could impair blood flow; during the oedema resolution phase (4–7 days post-operatively), stable pressure is maintained to ensure the dressing adheres to the wound; from day 8 post-operatively through to the wound healing and repair phase, pressure is slightly reduced to provide optimal conditions for epithelial tissue migration and repair. Monitor wound exudate throughout the process via the drainage channels, clear secretions promptly to keep the wound dry and clean, and carry out standardized oral care until the wound has completely healed.

2.3. Observation criteria

(1) Incidence of complications

Observe patients for post-operative dental damage, such as tooth mobility, palatal displacement, periodontal tenderness, and gingival recession, as well as the occurrence of wound infection, using symptoms such as redness and swelling of the wound, increased pain, purulent discharge, and elevated local skin temperature as criteria for diagnosis.

(2) Wound healing time

Record the time elapsed from the end of the operation until complete wound healing. The criteria for wound healing are: complete epithelialization of the wound surface; absence of bleeding or exudate; absence of redness, swelling, or inflammation; intact and continuous mucosa; and no obvious scar indentation.

(3) Comfort score

The Visual Analog Scale (VAS) was used to assess patients' postoperative comfort, with a score range of 0–10. A score of 0 indicates no discomfort whatsoever, whilst a score of 10 indicates severe distending pain, an extremely strong sensation of a foreign body, and intolerable discomfort; a higher score indicates greater discomfort.

2.4. Statistical methods

Data analysis and processing were performed using SPSS 26.0 statistical software. Quantitative data (wound healing time, VAS comfort scores) are expressed as 'mean ± standard deviation ($\overline{x} \pm s$)'. Comparisons between multiple groups were performed using one-way analysis of variance (ANOVA), whilst pairwise comparisons between groups were performed using the LSD-*t* test. Categorical data (incidence of dental tissue damage, wound infection rate) are expressed as 'number of cases (%)', and comparisons between groups were performed using the chi-squared χ^2 test. A *p*-value of < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of the incidence of postoperative complications among the three groups

Complications were monitored throughout the postoperative follow-up period. In Group A, 7 cases of dental tissue damage and 6 cases of wound infection were observed; in Group B, 6 cases of dental tissue damage and 8 cases of wound infection were observed; Group C had no cases of dental, periodontal injury or wound infection. Comparisons between Groups A and B showed $p > 0.05$ in all cases; however, comparisons between Group C and Groups A and B regarding the rates of dental injury and wound infection were statistically significant ($p < 0.05$). Specific data are shown in **Table 1**.

Table 1. Comparison of postoperative complication rates among the three groups [n (%)]

Group	Number of cases	Dental tissue injury [cases (%)]	Wound infection [cases (%)]
Group A	30	7 (23.33)	6 (20.00)
Group B	30	6 (20.00)*	8 (26.67)*
Group C	30	0 (0.00)	0 (0.00)
χ^2	-	5.822, 4.630	4.630, 7.067
p	-	0.016, 0.031	0.031, 0.008

Note: Compared with Group A, *$p > 0.05$

3.2. Comparison of wound healing times across the three groups

The wound healing time was (11.20 ± 1.52) days in Group A, (12.13 ± 1.81) days in Group B, and (8.31 ± 1.24) days in Group C. Comparisons between Groups A and B showed $p > 0.05$ in both cases, whilst comparisons between Group C and Groups A and B revealed statistically significant differences in wound healing time ($p < 0.001$). See **Table 2**.

Table 2. Comparison of wound healing times among the three groups of patients ($\overline{x} \pm s$, days)

Group	Number of cases	Wound healing time
Group A	30	11.20 ± 1.52
Group B	30	12.03 ± 1.81*
Group C	30	8.31 ± 1.24
t-value	-	8.070, 9.287
p-value	-	< 0.001, < 0.001

Note: Compared with Group A, *$p > 0.05$

3.3. Comparison of postoperative VAS comfort scores among the three patient groups

The results of the postoperative comfort assessment at 7 days showed that the VAS comfort score was (5.62 ± 1.13) points in Group A, (6.24 ± 1.30) points in Group B, and (2.83 ± 0.92) points in Group C. Comparisons between Groups A and B showed $p > 0.05$ in all cases. Group C was significantly lower than both Groups A and B, with the differences being statistically significant ($p < 0.001$). See **Table 3**.

Table 3. Comparison of postoperative VAS comfort scores among the three groups of patients ($\overline{x} \pm s$, points)

Group	Number of cases	VAS comfort score
Group A	30	5.62 ± 1.13
Group B	30	6.24 ± 1.30*
Group C	30	2.83 ± 0.92
t-value	-	10.487, 11.728
p-value	-	< 0.001, < 0.001

Note: Compared with Group A, *$p > 0.05$

4. Discussion

The quality of postoperative wound healing in the palate is directly related to surgical efficacy, the patient's postoperative pain levels, the restoration of oral function, and long-term quality of life. The unique anatomical location and physiological environment of the palate mean that postoperative wound healing is far more challenging than for skin or other oral mucosal wounds [5]. Precise postoperative compression, effective drainage, minimally invasive protection, and stable healing are the core requirements for palatal wound repair, and also represent the key focus and challenges of current clinical postoperative interventions. The purse-string suture with iodoform gauze compression method is the most widely used postoperative management technique for the palate in primary care hospitals; its advantages include ease of operation, no need for prefabricated splints, and immediate applicability, but its shortcomings are particularly pronounced [6,7]. This technique relies entirely on dental tissues to bear the tension of the sutures; continuous palatal traction stress acts directly on the periodontal ligament and the tooth. Prolonged traction can easily lead to hyperemia and edema of the periodontal ligament, as well as mild alveolar bone resorption, ultimately resulting in tooth mobility and displacement. This is also the primary reason for the high rate of dental damage (23.33%) observed in Group A in this study. Furthermore, rigid sutures lack elastic buffer space; when tissue at the surgical site swells and expands postoperatively, excessive tension in the sutures may compress the wound. Once the edema subsides, the sutures become slack, and the tension diminishes, making the dressing prone to displacement or detachment. This results in the interruption of pressure on the wound, causing the protective seal to fail, allowing saliva and contaminants to continuously invade the wound, thereby leading to wound infection and delayed healing, which significantly impairs postoperative recovery [8]. Traditional rigid palatal splints effectively resolve the issue of tooth structure damage associated with the purse-string suture technique, as they do not rely on tooth structure tension for fixation; however, their core shortcomings lie in the lack of pressure regulation, rigid fixation, and limited functionality. The rigid resin material lacks elasticity and adaptability, and is unable to adjust the pressure applied in response to the dynamic changes in tissue edema and its resolution, maintaining constant pressure throughout the entire process [9]. During the peak period of post-operative edema, high-pressure compression can disrupt local microcirculation at the wound

site, leading to tissue ischemia and hypoxia, hindering the migration of epithelial cells and stalling wound repair; once the edema subsides, the fit of the splint deteriorates; insufficient pressure causes the dressing to become loose and compromises the seal, significantly increasing the risk of bacterial proliferation. In this study, Group B exhibited a wound infection rate of 20.00% and the longest healing time, fully confirming the therapeutic limitations of traditional rigid palatal splints.

The novel elastic compression palatal splint developed by our research team integrates the anatomical characteristics of the palate with the physiological mechanisms of wound healing, achieving comprehensive innovation in materials, structure, and function. Its four core advantages thoroughly address the shortcomings of traditional surgical approaches. Firstly, the elastic, self-adaptive, pressure-equalizing design. The novel elastic compression palatal splint utilizes a medical-grade, highly elastic silicone substrate, which is soft and possesses excellent biocompatibility, allowing it to conform precisely to the curved anatomical contours of the palate. It adapts to the dynamic changes in post-operative tissue swelling and retraction, ensuring that the overall force applied to the wound is uniform and gentle, without localized stress concentration. This not only guarantees the hemostatic effect of pressure on the wound but also avoids compressing microvascular blood flow, providing a stable physiological environment for tissue repair and fundamentally preventing issues of excessive or insufficient pressure. Secondly, the new elastic compression palatal splint incorporates a built-in micro high-precision pressure monitoring module, which quantitatively displays the pressure applied to the wound in real time. This transforms the traditional, experience-based application of pressure by clinicians into a standardized, quantified process, eliminating blind spots in clinical practice and achieving 'precise compression based on evidence' [10]. Thirdly, the new elastic compression palatal splint utilizes an external micro-spiral pressure-adjustment component to fine-tune compression intensity in real time according to the differing physiological requirements of the wound's oedema, de-oedema and repair phases, thereby aligning with the wound's full-cycle healing process and enabling personalized, stage-specific, precise intervention; Fourthly, longitudinal drainage grooves are incorporated on the inner surface of the splint to promptly drain stasis, inflammatory exudates and secretions from the wound site, thereby preventing the accumulation of exudates that could lead to inflammatory infection. This ensures the wound remains dry and clean at all times, significantly reducing the risk of infection and accelerating the repair of the mucosal epithelium.

The data from this clinical controlled study fully validate the clinical advantages of the novel elastic compression palatal splint. In terms of complication prevention and control, Group C recorded no cases of tooth damage, completely avoiding the risk of tooth and periodontal damage associated with the purse-string suture technique; the wound infection rate was only 3.33 percent, significantly lower than that of Groups A and B, with the synergistic effect of the drainage and pressure-stabilizing structures effectively reducing the probability of post-operative infection. In terms of healing efficiency, wound healing time in Group C was reduced by 3–4 days compared with traditional surgical procedures. The integrated advantages of elastic pressure equalization, stabilized blood supply, and unobstructed drainage effectively accelerated epithelial migration and wound repair, shortening the patients' postoperative recovery period. In terms of patient experience, the VAS comfort score in Group C was only (2.83 ± 0.92) points. The soft, elastic material, absence of rigid compression, and excellent adaptability significantly reduced the sensation of a foreign body in the mouth and feelings of distension and pain, thereby markedly improving patients' postoperative quality of life.

5. Conclusion

In summary, the novel elastic compression palatal splint innovatively integrates four core functions: elastic adaptive compression, visual pressure monitoring, dynamic and precise pressure adjustment, and unobstructed wound drainage. It establishes an integrated, precise intervention system for post-operative palatal wounds, fundamentally overcoming the technical limitations of traditional purse-string suture compression and rigid palatal splint compression, effectively preventing postoperative complications such as dental and periodontal damage and wound infection, significantly shortening the wound healing period, and substantially enhancing patients' postoperative comfort and quality of life. It also offers clinical advantages, including ease of use, high safety, broad applicability, and excellent cost-effectiveness, aligning with the development principles of modern precision dentistry and rapid recovery surgery.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Zou C, Gong C, Jiang J, et al., 2025, Development and Clinical Application of a Novel Local Compression Band for the Oral and Maxillofacial Region. Chinese Journal of Oral and Maxillofacial Surgery, 23(02): 170–173.

[2] Yuan H, Li H, Jiao J, et al., 2025, Advances in Non-Pharmacological Management of Post-Operative Edema in Oral and Maxillofacial Surgery. General Nursing, 23(01): 67–71.

[3] Ha Y, 2024, A Study on the Clinical Efficacy of Internal Fixation Systems in Oral and Maxillofacial Surgery. Chinese Journal of Practical Medicine, 19(14): 77–80.

[4] Zhang D, Liu B, Yao Z, et al., 2024, Analysis of the Mechanism of Action of Elastic Sleeve Compression Bandaging in Preventing Postoperative Salivary Fistula in Patients with Benign Parotid Tumors. Chinese Health and Wellness, 42(12): 124–126.

[5] Zheng Y, Yan B, Zhong H, et al., 2023, The Effects of Compression Bandaging Using a Postoperative Parotid Compression Device on Postoperative Masticatory Function and the Incidence of Salivary Fistulae in Patients with Benign Parotid Tumors. Sichuan Medicine, 44(11): 1178–1181.

[6] Chen L, 2026, Clinical Efficacy of a Systematic Oral Care Intervention Model in Patients Undergoing Oral Cancer Surgery. Marriage, Childbearing and Health, 32(09): 157–159.

[7] Li H, Liang D, Lin J, et al., 2025, Development of a Nursing Protocol for the Prevention of Postoperative Pulmonary Infections in Patients Undergoing Oral and Maxillofacial Surgery. Chinese Journal of Integrated Traditional and Western Medicine in Emergency Medicine, 32(05): 611–615.

[8] Liu Y, Tian B, 2026, The Impact of Modified Oral Care on Patient Satisfaction and Complications in Oral and Maxillofacial Surgery Patients. Proceedings of the Academic Exchange Conference on Innovation in Clinical Medical Research: 4.

[9] Pang Y, Mao C, Li M, et al., 2024, The Efficacy of Palatal Splints Following Minimally Invasive Extraction of

Impacted Supernumerary Teeth on the Palatal Side of the Maxilla. Shandong Medicine, 64(19): 90–93.

[10] Ye J, Huang Q, 2019, Perioperative Care for Palatal Retainers Placed Concurrently With Maxillectomy for Malignant Oral Tumors. Proceedings of the 1st National Academic Conference on Oral and Maxillofacial–Head and Neck Oncology 2019: 1.

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Research on Weight-Adjusted Waist Circumference Index in Type 2 Diabetes and Complications: Current Development Status

Jie Zheng[1], Zhen Li[2]*

[1]Shaanxi University of Traditional Chinese Medicine, Xianyang 712046, Shaanxi, China
[2]Department of Endocrinology, Yulin Traditional Chinese Medicine Hospital, Yulin 719000, Shaanxi, China

***Corresponding author*:** Zhen Li, cathylin927@126.com

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Abstract: Weight-adjusted Waist Index (WWI) is a novel tool for evaluating human metabolism. By standardizing waist circumference with body weight, it compensates for the limitations of traditional Body Mass Index (BMI). It performs remarkably well in predicting health risks, including type 2 diabetes mellitus (T2DM), cardiovascular diseases, and metabolic syndrome. This paper summarizes the research progress of WWI in T2DM and its complications. It is found that WWI can effectively predict the onset of diabetes and various complications, with superior assessment efficacy compared with conventional indicators, and combined indexes possess higher predictive value. At present, WWI has not been widely applied clinically, and its diagnostic criteria and action mechanism remain to be further explored. After relevant research is improved, WWI is expected to serve as an effective assessment method for diabetes risk screening and complication early warning.

Keywords: Type 2 diabetes mellitus; Weight-adjusted waist index; Obesity; Diabetic complications

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1. Introduction

DM is a metabolic disease caused by multiple factors, which can lead to chronic progressive lesions in tissues and organs such as nerves, the cardiovascular system, the kidneys, and the eyes. In 2021, there were approximately 529 million DM patients worldwide, with a total prevalence of 6.1%. It is estimated that by 2045, this will rise to 12.2% (about 783.2 million people) with DM. DM and its complications are a financial burden for patients' families, and also a major public health issue that is more serious for our country. Relevant surveys show that the prevalence of DM was 11.9% in 2018–2019 [1]. Obesity is a chronic disease and a precursor to various diseases, such as T2DM. Comprehensive assessment and prevention of T2DM with obesity is a key direction in medical development. As an emerging evaluation tool, WWI has the

characteristics of being simple and easy to use, providing a new perspective for assessing health risks related to T2DM. Its core lies in standardizing waist circumference and weight, accurately reflecting the relationship between fat distribution and muscle mass, and offering advantages in cardiovascular diseases, metabolic syndrome, and other areas. In practical application, combining traditional indicators such as body mass index (BMI) and waist-to-hip ratio (WHR) enables more optimal individualized health management and provides more scientific intervention targets for the prevention and treatment of metabolic diseases.

2. Background of WWI and its clinical advantages

T2DM and obesity are closely related in terms of metabolism, sharing key physiological and pathological mechanisms [2]. BMI and WHR are traditional indices commonly used to assess body weight and fat distribution in patients with T2DM, but both are considered to have an "obesity paradox", which is more prominent in Asian populations. The obesity paradox refers to the abnormal phenomenon where obesity, which is a risk factor for chronic diseases, shows a lower mortality risk and better prognosis in mildly overweight populations. Based on this, some scholars believe that the obesity paradox is a statistical illusion caused by research design bias, measurement limitations, and other factors, rather than a real biological protective effect. They found that most of these studies were retrospective analyses, containing many confounding variables, and were not primarily aimed at studying the obesity paradox. Regarding the shortcomings of traditional indicators, Jaitovich et al. suggested that examinations such as CT should be combined for precise body composition assessment to distinguish between protective fat stores and harmful ectopic fat. In this context, Park et al. proposed a new index, WWI, by standardizing waist circumference by weight, achieving a weak correlation with BMI and a negative correlation with height. The formula for WWI is WWI = WC/√weight (cm/√kg), and it was validated using a large Korean cohort for its predictive value for the incidence and mortality of cardiometabolic diseases. In subsequent studies, Ji Yoon Kim, Jimi Choi, and others used CT data to study the relationship between WWI and abdominal fat and muscle indicators, further demonstrating that WWI is positively correlated with total abdominal fat, subcutaneous and visceral fat, and negatively correlated with abdominal muscle area and muscle density.

3. The role of WWI in the prediction and assessment of diabetes and its complications

3.1. Prediction and assessment of diabetes by WWI

WWI is closely related to T2DM. In the state of obesity, it triggers lipotoxicity and IR, leading to the occurrence of T2DM. Studies have shown that WWI is the best obesity indicator for predicting T2DM, outperforming traditional indicators (WC, BMI, WHR, body weight) [3]. At the same time, multiple large-scale studies show that WWI is significantly positively associated with the risk of T2DM. When WWI is at a high value, the risk of developing T2DM increases by 127%. Another research team conducted a longitudinal study using a Japanese database, and after fully adjusting the model, found that for each 1-unit increase in WWI, the risk of T2DM increases by 1.96 times, and the highest quartile of WWI has a 2.33 times higher risk of T2DM compared to the lowest quartile. In a cross-sectional stratified study based on the 2017–2020 National Health and Nutrition Examination Survey (NHANES) database in the United States, Researchers included 7,973 participants and found that for each 1-unit increase in WWI, the risk of developing diabetes increased by 111%. In comparison, for each 1-unit increase in BMI and WC, the risk of T2DM only

increased by 5% and 3%, respectively. Different research results also exist, and researchers used the Cox regression model to verify whether WWI could predict T2DM. It was found that the effectiveness was lower than that of traditional indicators such as BMI and WC. The possible reason is that the original data limited the secondary analysis and could not completely rule out confounding factors (such as dietary details, exercise intensity, etc.), and no dynamic diagnosis was conducted during follow-up, which underestimated the incidence of T2DM. Additionally, the study population being a single Japanese ethnicity may also be an influencing factor. In a small-sample study in Iran, Researchers included 215 participants with prediabetes at baseline (≥ 35 years old, 40.5% male) from the prospective cohort of the Isfahan Cohort Study (ICS) in Iran and conducted a 13-year follow-up. They found that WWI had no significant predictive value for T2DM progression in this population. The study analyzed the reasons, which may be related to the sample coming from a specific population in central Iran, the lack of dynamic analysis of relevant indicators, baseline HbA1c not being measured, and diagnoses relying only on fasting blood glucose (FBG) and 2-hour postprandial glucose (2hPPG), leading to certain biases in the results.

Regarding patient characteristics, Zheng et al conducted a cross-sectional study using NHANES data from 2007–2018 and found that the association between WWI and T2DM was particularly significant in the population under 60 years of age, suggesting that WWI is more suitable for assessing T2DM risk in young adults [4]. In another study based on the same NHANES data. Scholars have found that a high WWI value is significantly associated with the prevalence of T2DM in American adults under 40 years old. In different racial populations, a longitudinal study in Japan found an interaction between WWI and age (p = 0.023), with WWI being more sensitive in predicting young adults. There are also studies based on rural and urban populations. Wu Qingzheng, Li Bing, and others used the REACTION study database (Cancer Risk Assessment in Chinese People with Diabetes), including 50,978 adults from eight urban areas in China (Dalian, Lanzhou, Zhengzhou, Guangzhou, Guangxi, Luzhou, Shanghai, and Wuhan), and found that WWI was significantly positively associated with the risk of T2DM in Chinese urban adults. This association was more pronounced in younger middle-aged (< 60 years) overweight/obese (BMI ≥ 24 kg/m^2) men, reflecting T2DM-related central obesity characteristics more accurately than traditional indicators. Another study focused on rural areas in Liaoning, China. WWI is considered an independent factor for T2DM patients in rural areas, unrelated to traditional risk factors, and can serve as a simple and effective tool for early identification and prevention, with significant public health implications. Regarding education level, interaction tests in studies have shown that the association between WWI and T2DM remains stable across subgroups with different ages, races, education levels, marital status, hypertension status, moderate activity levels, and smoking status. Education levels above high school more significantly affect the relationship between WWI and T2DM and show a significant positive correlation, with the association strength clearly exceeding that of BMI and WC.

3.2. Correlation between WWI and Type 2 diabetes combined with cardiovascular disease (CVD)

DM is still significantly associated with all-cause mortality and cardiovascular diseases. The link between WWI and cardiovascular disease is related to the vicious cycle of dysfunctional adipose tissue, oxidative stress, and chronic inflammation. The core mechanism is as follows: long-term energy surplus exceeds the compensatory storage capacity of subcutaneous fat, causing pathological hypertrophy of adipocytes, leading

to local hypoxia, immune infiltration, and dysregulated secretion of adipokines, such as reduced adiponectin and leptin resistance [5]. At the same time, it causes excessive lipids to accumulate in tissues such as internal organs, blood vessels, and the liver, inducing systemic metabolic disorders. On one hand, the free fatty acids released by visceral fat accumulation can activate related lipid metabolism pathways and block insulin signaling. Fatty degeneration of the liver further exacerbates glucose and lipid metabolism disorders, jointly inducing IR; On the other hand, dysfunctional adipose tissue produces a large amount of reactive oxygen species, Induce oxidative stress, And activate inflammatory pathways such as NF-κB and TLR, promoting the massive release of pro-inflammatory factors such as TNF-α and IL-6, Forming a vicious cycle in which oxidative stress and chronic inflammation reinforce each other, continuously aggravating insulin resistance. On this basis, the secretory function of perivascular adipose tissue becomes disordered, combined with the abnormal activation of oxidases by oxidized low-density lipoprotein, inducing macrophages to promote atherosclerotic transformation, damaging vascular endothelial function, and reducing nitric oxide utilization. At the same time, the visceral fat fibrosis caused by abnormal fat expansion further consolidates systemic metabolic disorders. The synergistic effect of multiple mechanisms ultimately promotes the occurrence and development of cardiovascular metabolic diseases such as hypertension and atherosclerosis.

A large-scale cross-sectional study based on NHANES collected 44,528 data samples and found that WWI is positively correlated with an increased risk of coronary heart disease, and it surpasses traditional indicators and other new indicators, making it a reliable independent predictor of adverse health outcomes [6]. Another study analyzed data from 4,937 participants across seven NHANES cycles between 2007 and 2020, finding that WWI increased the cardiovascular disease risk in patients with DM, and pointed out that sedentary behavior is an important risk factor. Maojun Liu, Junyu Pei, and others used the Cox proportional hazards regression model and found that for each one standard deviation increase in WWI, the risks of major adverse cardiovascular events (MACEs), composite cardiovascular outcomes, congestive heart failure (CHF), and total mortality (TM) in T2DM patients increased by 7%, 9%, 20%, and 11%, respectively, and it predicted heart failure (HF) more accurately in patients with a disease duration of less than 10 years. Qi Sun, Yang Yang, and others similarly used NHANES data and confirmed through a logistic regression model that WWI is significantly and independently positively correlated with the risk of hypertension (HTN), with the highest quartile group having a 2.94 times higher risk than the lowest group (95% CI: 2.65–3.27, $p < 0.001$). Daoliang Zhang, based on a study of 25,509 participants in NHANES, found that after adjusting for multiple confounding factors, for each 1-unit increase in WWI, the risk of HF increased by 19.5%; in quartile analysis, the highest group had a 1.670 times higher risk of HF compared to the lowest group. It can be seen that WWI is significantly linearly associated with HF risk and can be used for risk screening of HF in the general population. Arterial stiffness (AS) is an important condition for cardiovascular disease, and obesity is also an important risk factor for AS, CVD, and other diseases. Compared with other traditional obesity indices, WWI has a higher correlation with AS risk. Some researchers, while exploring the relationship between the incidence of carotid atherosclerosis (CAS) and WWI in Chinese patients with T2DM, included data from 801 adult patients and conducted a retrospective cross-sectional analysis, finding that WWI was independently associated with the occurrence of CAS, suggesting that WWI can be used as a simple indicator to assess the risk of CAS in Chinese T2DM patients. In another study exploring the association between WWI and the risk of CAS in the Chinese community, based on continuous health examination data from 2012 to 2018, 4,671 subjects without CAS at baseline were included. A prospective cohort study design was

used, and after a follow-up of 6.62 years, a total of 2,806 new CAS events occurred. It was found that WWI was significantly positively associated with CAS risk, and it was also considered that WWI can serve as a simple and effective indicator for identifying high-risk individuals for CAS in the general adult population of the Chinese community.

In terms of all-cause mortality, a study based on the NHANES research indicated that WWI has a long-term synergistic negative effect on all-cause mortality and cardiovascular mortality in T2DM patients, and can serve as an independent predictor of mortality in T2DM patients [7]. Cardiometabolic syndrome (CMS) is closely related to an increased risk of cardiovascular disease, T2DM, and all-cause mortality. In this regard, a study based on the 2003–2018 U.S. NHANES data included 6,506 CMS patients to investigate the association between WWI and all-cause mortality in CMS patients, and to analyze the potential mediating role of inflammatory markers. The results showed that WWI is an independent predictor of all-cause mortality in CMS patients, with inflammation playing a key mediating role in this association. The mediation effects of neutrophils, systemic immune-inflammation index (SII), neutrophil-to-lymphocyte ratio (NLR), and white blood cells were 24.52%, 22.64%, 17.7%, and 14.6%, respectively. Consistent with the population characteristics of this group, obesity itself represents a state of chronic low-grade inflammation, which can further drive the progression of cardiovascular disease and diabetes through mechanisms such as atherosclerosis, insulin resistance, and pancreatic β-cell dysfunction. Regarding research on WWI-related thresholds, some studies have found that in hypertensive patients with hypertension and obstructive sleep apnea (OSA), WWI has a J-shaped relationship with cardiovascular disease, especially when WWI exceeds 11.5 cm/√kg, at which point the risk of cardiovascular disease increases significantly. Another cross-sectional study including more than 30,000 participants based on the 1999–2014 NHANES found a nonlinear positive correlation between WWI and myocardial infarction, with a threshold of 11.15 cm/√kg that can be used to predict myocardial infarction, surpassing traditional indicators such as WC and BMI.

3.3. Correlation of WWI with diabetic nephropathy

3.3.1. Diabetic nephropathy

The pathogenesis of diabetic kidney disease (DKD) is a complex process in which multiple pathogenic pathways intertwine and amplify step by step, ultimately leading to irreversible renal function decline. It involves the following aspects:

(1) Metabolic disorder is the initiating factor, with hyperglycemia being the most upstream driving force. It initiates damage through three classical pathways: the polyol and protein kinase C pathways, advanced glycation end products, and gut microbiota dysbiosis. At the same time, hyperglycemia induces podocytes and renal tubular epithelial cells to produce large amounts of reactive oxygen species, promoting lesions through NLRP3 inflammasomes, epithelial-mesenchymal transition, and apoptosis.

(2) Obesity turns adipose tissue into a pro-inflammatory organ, with excessive secretion of pro-inflammatory factors such as TNF-α and IL-6, leading to macrophage infiltration and sustained activation of the NF-κB pathway. Protective factors like adiponectin decrease (adiponectin exerts renoprotective effects through the AdipoR1/AMPK and AdipoR2/PPAR-α pathways), and its deficiency aggravates oxidative stress, causing the inflammation-fibrosis cascade to go out of control. TNF-α mediates podocyte damage through NF-κB, and IL-1β links hyperglycemia to macrophage infiltration, participating in renal tubulointerstitial fibrosis.

(3) Fibrosis is a common final pathway. Under persistent inflammation and oxidative stress, the TGF-β/Smad2/3 axis becomes the central regulatory hub of fibrosis, with Smad3 mediating the cascade between inflammation and fibrosis, upregulating extracellular matrix components such as fibronectin, promoting the accumulation of myofibroblasts and extracellular matrix deposition, leading to renal tubular interstitial fibrosis and glomerulosclerosis, ultimately causing an irreversible decline in glomerular filtration rate.

(4) Early glomerular hyperfiltration and subsequent glomerular hypertension are closely related to excessive local RAAS activation and the strong vasoconstrictive effect of endothelin-1. Angiotensin II induces reactive oxygen species production and podocyte injury, while aldosterone upregulates profibrotic factors such as TGF-β; endothelin-1 activates pro-inflammatory and profibrotic pathways, promoting mesangial proliferation and proteinuria [8].

In summary, the four major mechanisms, namely, metabolic disorder, chronic inflammation, fibrosis, and hemodynamic abnormalities, work together to lead to progressive loss of kidney function. Using a study from NHANES, which included 10,661 patients diagnosed with T2DM, the overall prevalence of DKD was 20.74%. The study results indicate that WWI can serve as a new index to predict DKD, with a stronger predictive ability than BMI [9]. Another retrospective analysis from China, involving 860 adult patients, investigated the relationship between WWI and albuminuria in T2DM patients. It found that WWI is an independent risk factor for albuminuria in T2DM patients. The area under the curve (AUC) of WWI for predicting albuminuria was 0.605. WWI is independently associated with albuminuria in Chinese T2DM patients and may serve as a simple indicator for assessing the risk of albuminuria.

3.3.2. WWI and kidney stones

Obesity, diabetes, hypertension, and metabolic syndrome are all considered risk factors for kidney stone formation. Kidney stones, in turn, may lead to hypertension, chronic kidney disease, and end-stage renal disease. The accumulation of non-esterified fatty acids in renal cells may interfere with cellular metabolism in proximal tubular cells, leading to a decrease in ammonia production. The reduced ammonia output may result in kidney damage, thereby promoting the formation of kidney stones. There is an independent association between WWI and an increased risk of kidney stones. Individuals in the highest third of WWI have a higher risk of disease compared to those in the lowest third. T2DM partially mediates this relationship. Firstly, IR can promote the excretion of uric acid and oxalate, thereby inducing stone formation; secondly, adipose-derived inflammatory mediators can lower urine pH and increase oxalate levels; chronic low-grade inflammation can disrupt calcium and uric acid metabolism and damage renal tubules; lipid metabolism disorders can independently increase the risk of kidney stones through oxidative stress and renal tubular injury. In addition, the aforementioned inflammatory and metabolic abnormal pathways can also interact with diabetic effects, further increasing the risk of kidney stones in individuals with a high waist-to-height ratio. A cross-sectional study based on the NHANES database, including 31,344 adult participants during the period from 2007 to 2018. Studies have shown that obesity increases the risk of kidney stones, regardless of whether the participants have metabolic syndrome. Other researchers used data from NHANES to conduct multiple logistic regression analyses. Assess the association between WWI and the prevalence of kidney stones, and perform subgroup analyses for susceptible populations. It was also found that WWI is positively associated with the incidence of kidney stones, and this association should be more pronounced in people aged 20 to 39,

males, other U.S. ethnic groups, and participants without HTN or T2DM.

3.4. Development of research on WWI in diabetic peripheral neuropathy

Metabolic syndrome in DM patients is a major risk factor for diabetic peripheral neuropathy (DPN). However, obesity can independently damage the peripheral nervous system through two core pathways, leading to peripheral neuropathy: first, the chronic inflammation pathway, which disrupts the blood-nerve barrier, activates neuroinflammation, and directly damages nerve structures; second, the lipid metabolism disorder pathway, where excessive accumulation of long-chain fatty acids (LCFA) induces endoplasmic reticulum stress in Schwann cells, mitochondrial dysfunction, and calcium imbalance, causing an energy metabolism collapse, compounded by mitochondrial transport disorders, with lipid toxicity and inflammation synergistically aggravating nerve damage [10]. WWI is closely related to abdominal visceral fat. As abdominal obesity increases, the combination of chronic low-grade inflammation and insulin signaling impairment can weaken the ability of neurons to cope with metabolic stress and oxidative challenges, thereby promoting the development of neurodegenerative diseases. A study involving 1,790 participants analyzed the relationship between WWI, BMI, WC, and DPN using logistic regression and other methods, and assessed the diagnostic performance of obesity indices using ROC-AUC. It was found that when WWI was greater than 10.757 cm/√kg, WWI had a linear relationship with DPN (odds ratio: 1.375, 95% confidence interval: 1.115–1.7). ROC analysis showed that the diagnostic performance of WWI was better than that of BMI and WC. WWI is linearly and independently associated with DPN, and its stability and predictive value are superior to those of BMI and WC. Some researchers conducted a cross-sectional study based on the U.S. NHANES database to analyze the relationship between body shape index (ABSI), weight-adjusted waist index (WWI), and serum neurofilament light chain (sNfL) levels. They found that both indicators were positively linearly associated with sNfL.

3.5. Development of the WWI index

The triglyceride-glucose index (TyG) is a reliable alternative biomarker for assessing insulin resistance in diabetic patients and is closely related to the incidence of various cardiovascular and kidney diseases. However, it does not take into account the impact of obesity on insulin resistance, and its accuracy in assessing IR is superior to HOMA-IR, with lower cost; WWI can more accurately reflect visceral fat accumulation, differentiate between fat and muscle mass, avoid the “obesity paradox” of BMI and WC, and visceral fat is a key risk factor for the development of DM, having a mutually reinforcing pathological relationship with IR; therefore, a large-sample study based on NHANES. For the first time, TyG was combined with WWI to form the TyG-WWI composite index. Studies have shown that it is significantly superior to the TyG index alone and other TyG-derived indices such as TyG-WC, TyG-BMI, and TyG-WHR. The ROC curves indicate that TyG-WWI has the highest AUC for all outcomes: diabetes (0.81), all-cause mortality (0.69), CVD mortality (0.71), and diabetes-related mortality (0.85). In other studies, related to TyG-WWI, it also reached similar conclusions. Another prospective cohort study was based on the China Health and Retirement Longitudinal Study (CHARLS) database. A total of 5,555 middle-aged and elderly individuals aged 45 and above without T2DM were included and followed up for 9 years. For the first time, the interaction between TyG and WWI was investigated for its impact on the risk of developing T2DM in the Chinese middle-aged and elderly population. It was confirmed that both are independent risk factors for DM,

and their combined predictive clinical value is significantly higher than that of a single indicator. Essentially, this reflects the pathological overlay of IR and central obesity. Combined evaluation can simultaneously capture metabolic abnormalities and abnormal fat distribution, compensating for the limitations of a single indicator.

In terms of cardiovascular and cerebrovascular diseases, TyG-WWI also shows advantages in an ACCORD/ACCORDION cohort. Researchers have found that higher TyG-WWI is significantly associated with an increased risk of major adverse cardiovascular events (MACEs), severe coronary heart disease (CHD), congestive heart failure (CHF), and total mortality (TM). TyG-WWI outperforms TyG in predictive accuracy, and for patients under 65 years old, TyG-WWI shows stronger predictive ability for CHF. Another study, based on middle-aged and elderly populations, revealed a significant association between TyG-WWI and stroke, with a 11% increase in stroke risk for each standard unit increase in TyG-WWI. Insulin resistance (IR) and obesity are important components of metabolic syndrome, both of which may increase the risk of stroke. IR is known to contribute to the development of atherosclerosis, leading to vascular intimal hyperplasia and the formation of atherosclerotic plaques, and is significantly associated with the incidence of stroke. It may also hinder the utilization of nitric oxide, thereby impairing endothelial function and increasing the risk of stroke.

4. Summary

WWI compensates for the shortcomings of traditional indicators such as BMI and WC, can to some extent avoid the obesity paradox, reflects fat and muscle distribution, and has good predictive effects on the onset of T2DM and IR. This index can also assess the risk of various complications, including cardiovascular, renal, and peripheral nerve diseases, with predictive performance superior to conventional body fat indicators. The TyG-WWI combined index integrates features of IR and abdominal obesity, further enhancing the ability to predict diseases and adverse outcomes. Most studies recognize the excellent evaluation value of WWI, but a few studies have results that contradict it. These differences arise from individual variations in population ethnicity, age, and lifestyle habits, the size of the study sample, follow-up methods, inconsistent diagnostic standards, and differing levels of confounding variable control, such as diet and exercise. WWI is associated with various forms of disease, and the critical thresholds differ. Currently, WWI remains at the research stage, has not been included in clinical guidelines, and lacks unified reference values for the Chinese population; the underlying mechanisms related to complications are not yet fully clarified; local population data are limited, and research on special populations is insufficient; multi-indicator combined evaluation systems are immature, and long-term follow-up studies for indicator-based stratified interventions are lacking. In the future, large-sample local studies should be conducted to establish WWI reference standards suitable for the Chinese population; further clarify the related pathogenic mechanisms such as inflammation and lipid metabolism; expand research data on populations with different characteristics; build multi-indicator combined evaluation models; carry out intervention trials to verify the practical value of the index in guiding clinical diagnosis and treatment, and promote its application in clinical practice.

5. Conclusion

WWI can objectively assess the degree of abdominal obesity and has prominent advantages in evaluating

the risk of onset and complications of T2DM. The combined index detection is even more effective. At present, there are still many shortcomings in the application of this indicator. After further improvement of related studies, WWI is expected to become an effective auxiliary tool for T2DM screening and complication warning, providing a reference for chronic disease prevention and control.

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Disclosure statement

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References

[1] Chinese Medical Association Diabetes Society, 2025, Chinese Guidelines for the Prevention and Treatment of Diabetes (2024 Edition). Chinese Journal of Diabetes, 17(01): 136–139.

[2] Lingvay I, Sumithran P, Cohen R, et al., 2022, Obesity Management as a Primary Treatment Goal for Type 2 Diabetes: Time to Reframe the Conversation. Lancet, 399(10322): 394–405.

[3] Park Y, Kim N, Kwon T, et al., 2018, A Novel Adiposity Index as an Integrated Predictor of Cardiometabolic Disease Morbidity and Mortality. Scientific Reports, 8(1): 16753.

[4] Zheng D, Zhao S, Luo D, et al., 2023, Association Between the Weight-Adjusted Waist Index and the Odds of Type 2 Diabetes Mellitus in United States Adults: A Cross-Sectional Study. Frontiers in Endocrinology (Lausanne), 14: 1325454.

[5] Piché M, Tchernof A, Després P, 2020, Obesity Phenotypes, Diabetes, and Cardiovascular Diseases. Circulation Research, 126(11): 1477–1500.

[6] Liu Y, Sun S, Zou Q, et al., 2024, Correlation Between Weight-Adjusted Waist Index and Coronary Heart Disease: NHANES 1999–2020. Frontiers in Cardiovascular Medicine, 11: 1445802.

[7] Zhang Y, Zhang M, Wang X, et al., 2024, Relationship Between Weight-Adjusted-Waist Index and All-Cause and Cardiovascular Mortality in Individuals with Type 2 Diabetes. Diabetes, Obesity and Metabolism, 26(12): 5621–5629.

[8] Watanabe K, Sato E, Mishima E, et al., 2022, What's New in the Molecular Mechanisms of Diabetic Kidney Disease: Recent Advances. International Journal of Molecular Sciences, 24(1): 570.

[9] Ding Y, Lv S, Xie R, et al., 2024, Association of Weight-Adjusted Waist Index and Diabetic Kidney Disease in Type 2 Diabetes Mellitus. Endocrine Connections, 13(4): e230491.

[10] O'Brien P, Hinder L, Callaghan B, et al., 2017, Neurological Consequences of Obesity. Lancet Neurology, 16(6): 465–477.

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Effects of Zhuang Medicine Longzuan Tongbi Decoction on Left Ventricular Remodeling in Rats with Myocardial Infarction

Zheng Huang[1], Qiao Zeng[2], Jianhui Gu[2], Liping Lu[1], Dafen Li[1], Yongxi Zhou[1]*

[1]Fusui County Hospital of Traditional Chinese Medicine, Chongzuo 532100, Guangxi Zhuang Autonomous Region, China
[2]Guangxi University of Chinese Medicine, Nanning 530000, Guangxi Zhuang Autonomous Region, China

Author to whom correspondence should be addressed.

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Abstract: *Objective:* To investigate the effects of Longzuan Tongbi Decoction on ischemic myocardial angiogenesis in rats with myocardial infarction (MI), and to analyze its regulatory effect on the expression of angiogenesis-related factors. *Methods:* A total of 120 healthy, clean-grade female Sprague-Dawley (SD) rats were randomly divided into six groups (20 rats per group): sham surgery (normal control) group, model group, Shexiang Baoxin Pill (positive control) group, as well as low-, medium-, and high-dose groups of Longzuan Tongbi Decoction. The MI model was established by left coronary artery ligation; the sham surgery group underwent threading without ligation. Postoperatively, each treatment group received daily oral administration of the corresponding medicine (the low-, medium-, and high-dose groups of Longzuan Tongbi Decoction received 1 mL, 2 mL, and 4 mL of the extract, respectively; the positive control group received Shexiang Baoxin Pill), while the sham surgery and model groups received an equal volume of saline. Treatment continued for 6 weeks. At the end of the experiment, the ratio of myocardial infarct size to left ventricular area was measured, and the number and density of microvessels in the MI border zone were assessed. *Results:* Compared with the model group, the ratio of myocardial infarct size to left ventricular area was significantly reduced in each dose group of Longzuan Tongbi Decoction ($p < 0.05$), and the efficacy was comparable to that of the Shexiang Baoxin Pill group. Regarding angiogenesis promotion, the number and density of microvessels in the infarct border zone were significantly higher in each dose group of Longzuan Tongbi Decoction than in the model group ($p < 0.05$); among these, the pro-angiogenic effect of the medium- and high-dose groups was significantly superior to that of the Shexiang Baoxin Pill group ($p < 0.05$), while no significant difference was observed between the low-dose group and the positive control group ($p > 0.05$). *Conclusion:* Longzuan Tongbi Decoction can effectively reduce the extent of myocardial infarction and exert a cardioprotective effect by promoting local angiogenesis in ischemic myocardium, and this effect exhibits a dose-dependent relationship within a certain range.

Keywords: Zhuang Medicine Longzuan Tongbi decoction; Myocardial infarction; Angiogenesis

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1. Introduction

Coronary heart disease and myocardial infarction are among the cardiovascular diseases with the highest mortality and disability rates worldwide. According to statistics, approximately 3.5 million people die from cardiovascular diseases in China each year, with myocardial infarction accounting for over 70% of these cases. The condition not only seriously endangers people's life and health, but also imposes a heavy medical and economic burden on society and families [1]. Following myocardial infarction, restoring blood supply to the ischemic myocardium is the core to improving patient prognosis. Clinically, around 30% of patients with coronary heart disease cannot achieve complete revascularization due to diffuse multi-vessel disease; therefore, promoting the formation of collateral circulation in ischemic areas through pharmaceutical intervention has become a critical scientific challenge in the field of cardiovascular medicine [2]. This study focuses on Zhuang medicine with distinctive ethnic medical characteristics. Longzuan Tongbi Decoction is a compound prescription derived from the folk experience of the Zhuang nationality and formulated based on the Zhuang medical theory of "removing toxin and unblocking vessels". Previous studies have suggested its potential in cardiovascular protection. Through animal experiments, this study aims to systematically investigate the effects of this formula on ischemic myocardium angiogenesis in rats with myocardial infarction. Specifically, by measuring the ratio of myocardial infarct size to left ventricular area and quantitatively analyzing key morphological indicators such as myocardial microvascular count (MVC) and microvascular density (MVD) in the MI border zone, the study preliminarily explores its potential mechanisms in promoting angiogenesis and improving myocardial perfusion. It is expected that this study can provide a potential new pharmaceutical intervention strategy to address the aforementioned clinical challenges, and offer experimental evidence for the modern development and clinical application of traditional ethnic medicine.

2. Experimental materials

2.1. Animals

A total of 120 clean-grade, healthy female SD rats weighing (230 ± 20) g were purchased from the Animal Center of Zhengzhou University (Animal Certificate No.: 410156). The rearing environment complied with the national standard of Laboratory Animal Environment and Facilities (GB 14925-2010). All rats were given free access to food and water. The formal experiment was initiated after one week of adaptive feeding.

2.2. Medicines and reagents

Longzuan Tongbi Decoction (composed of *Radix Toddaliae Asiaticae* (Feilongzhangxue) 30 g, *Radix Kadsurea Coccineae* (Dazuan) 20 g, *Radix Alangii Chinensis* (Bajiaofeng) 15 g, *Radix Zanthoxyli* (Liangmianzhen) 15 g, *Caulis Sinomenii* (Qingfengteng) 15 g, *Rhizoma Smilacis Glabrae* (Tufuling) 15 g, *Caulis Spatholobi* (Jixueteng) 30 g, *Herba Plantaginis* (Cheqiancao) 15 g, *Rhizoma Dioscoreae Hypoglaucae* (Bixie) 15 g and *Pseudobulbus Cremastrae seu Pleiones* (Shancigu) 10 g) was purchased and decocted into extract by the Pharmacy Department of Fusui County Hospital of Traditional Chinese Medicine; 1 mL extract is equivalent to 1 g of crude herb. Shexiang Baoxin Pill (produced by Shanghai Hutchison Pharmaceutical Co., Ltd.; Batch No. A040214; 22.5 mg per pill). DAB Staining Kit (Beijing Zhongshan Company), 1% Pentobarbital Sodium (analytical pure, Sinopharm Chemical Reagents Co., Ltd.), Benzylpenicillin Sodium Injection (North China Pharmaceutical Co., Ltd.).

2.3. Equipment

Small Animal Ventilator (TKR-200C, Jiangxi Teli Anesthesia & Respiratory Equipment Co., Ltd.); Optical

Microscope (CH20BIMF200, OLYMPUS Optical Co., Ltd., Japan); Paraffin Microtome (HM340E, Carl Zeiss AG, Germany); Medical Image Analysis System (BT 2000, Version 3.6 Build 0211, Chengdu Taimeng Technology Co., Ltd.); High-Resolution Color Pathological Image Analysis System (Noesis S.A., France).

3. Experimental methods

3.1. Preparation of animal model

The myocardial infarction model was established according to the Laboratory Animal Science [3]. Rats were anesthetized via intraperitoneal injection of 1% Pentobarbital Sodium, fixed in the supine position, and subjected to tracheal intubation connected to a small-animal ventilator for mechanical ventilation. The chest was opened, and the root of the left coronary artery was ligated. The ligation site was 0.1 cm below the line between the aortic conus and the left atrial appendage on the main trunk of the left coronary artery. Successful model establishment was confirmed by immediate changes in cardiac surface color and significant ST-segment elevation in leads I and aVL of the surface electrocardiogram. After suturing the chest wall and observing that the rats' physiological status had stabilized, artificial respiration was discontinued. Postoperatively, penicillin was administered for 3 days to prevent infection. The surviving rats were randomly divided into the model group, Shexiang Baoxin Pill group, high-dose group of Longzuan Tongbi Decoction, medium-dose group of Longzuan Tongbi Decoction, and low-dose group of Longzuan Tongbi Decoction. Rats in the sham surgery group underwent the same procedure as described above, except that a loose knot was made under the coronary artery without ligation. All rats were euthanized after 6 weeks for subsequent index detection.

3.2. Animal grouping and administration methods

A total of 120 healthy, clean-grade female SD rats weighing 200 ± 20 g were randomly divided into six groups (A, B, C, D, E, and F), with 20 rats in each group. A: normal control group; B: model group; C: Shexiang Baoxin Pill group; D: low-dose group of Longzuan Tongbi Decoction (1 mL); E: medium-dose group of Longzuan Tongbi Decoction (2 mL); F: high-dose Longzuan Tongbi Decoction group (4 mL). (The dosages were converted according to the body surface area of experimental animals. The medication groups were administered via gavage at 8:00 a.m. daily; the control and model groups received an equal volume of saline via gavage, once daily. All rats were reared in separate cages with free access to food and water.

3.3. Collection and processing of myocardial tissue

After anesthetizing the rats, the hearts were quickly removed. The aortic arch, right ventricle, atria, and auricles were excised. Myocardial tissue (including the infarct area, transition area, and intact area) was harvested from the transverse section of the papillary muscles, fixed in 10% neutral buffered formalin, embedded in paraffin, and prepared into 4 μm thick sections. Partial myocardial tissues from the MI border zone were preserved in liquid nitrogen for subsequent use.

3.4. Observation indicators and detection methods

3.4.1. Measurement of myocardial infarct size

The fixed heart was embedded in paraffin and sectioned, followed by hematoxylin and eosin (HE) staining. Myocardial necrosis was observed under a light microscope. The ratio of myocardial infarct size to left

ventricular area was measured using a high-resolution color pathological image analysis system (Noesis S.A., France). Infarct size (%) = Myocardial infarct size / Left ventricular area × 100%.

3.4.2. Determination of microvascular count (MVC) and microvascular density (MVD) in the MI border zone

Tissue sections were stained via the immunohistochemical SP method. After staining, vascular endothelial cells appeared yellow and brown.

(1) Criteria for microvessel identification

Vessels were not identified based on the presence of red blood cells or vascular lumens. Any single brownish-yellow endothelial cell or cluster of endothelial cells was counted as one vessel. Vessels with lumens larger than the size of eight red blood cells or those surrounded by thick muscular layers were not counted.

(2) Procedures

First, locate the MI border zone under 40 × magnification. Then, count the microvessels in this region under 400 × magnification. Randomly select five visual fields for each section, record the MVC of each field, and calculate the mean as the MVC value of the rat. Since MVD was expressed as the number of microvessels per visual field, the MVC value for each rat is equivalent to the MVD value for that rat.

3.5. Statistical methods

All data were analyzed using SPSS 32.0 statistical software. Measurement data were expressed as "mean ± standard deviation ($\overline{x} \pm s$)"; comparisons between groups were performed using the independent samples *t* test. Enumeration data were presented as "number of cases (percentage)"; comparisons between groups were performed using the χ^2 test. Ranked data were analyzed by rank sum test. $p < 0.05$ was considered statistically significant.

4. Results

4.1. Comparison of myocardial infarct size among groups

After 6 consecutive weeks of intervention, the ratio of myocardial infarct size to left ventricular area was compared across groups. Compared with the normal control group, the ratio was significantly elevated in the model group and all treatment groups (Shexiang Baoxin Pill group, and the low-/medium-/high-dose group of Zhuang Medicine Longzuan Tongbi Decoction), with statistically significant differences ($p < 0.05$); compared with the model group, the ratio of infarct size to left ventricular area was significantly reduced in each dose group of Longzuan Tongbi Decoction and Shexiang Baoxin Pill group, with statistically significant differences ($p < 0.05$); compared with the Shexiang Baoxin Pill group, there were no statistically significant differences in this ratio among the low-, medium-, and high-dose groups of Longzuan Tongbi Decoction ($p > 0.05$), indicating that Zhuang Medicine Longzuan Tongbi Decoction exerted a comparable effect on reducing infarct size to Shexiang Baoxin Pill group. Detailed data are shown in **Table 1**.

Table 1. Effect of different dose groups of Zhuang Medicine Longzuan Tongbi Decoction on myocardial infarct size in rats ($\overline{x} \pm s$, $n = 20$)

Group	*n*	Left ventricle area	Myocardial infarct size	Infarct size (%)
Normal control group	20	6.52 ± 1.45	6.18 ± 0.76	85.37 ± 7.82
Model group	20	11.38 ± 1.26	9.65 ± 0.83	86.42 ± 4.53
Shexiang Baoxin pill group	20	8.45 ± 1.21	7.79 ± 0.72	87.26 ± 8.15
Low-dose group of Zhuang medicine Longzuan Tongbi Decoction	20	8.39 ± 1.32	7.68 ± 0.75	87.35 ± 8.21
Medium-dose group of Zhuang medicine Longzuan Tongbi Decoction	20	7.96 ± 1.35	7.37 ± 0.65	87.51 ± 8.34
High-dose group of Zhuang medicine Longzuan Tongbi Decoction	20	7.38 ± 1.29	7.22 ± 0.61	87.63 ± 8.42

Compared with the normal control group, $p < 0.05$; Compared with the model group, $p < 0.05$; Compared with Shexiang Baoxin Pill group, $p > 0.05$

4.2. Comparison of microvascular count (MVC) and microvascular density (MVD) in the MI border zone across groups

New microvessels were observed in the MI border zone of all groups. Comparison of MVC and MVD revealed that, compared with the normal control group, both MVC and MVD were significantly elevated in the model group and all treatment groups, with statistically significant differences ($p < 0.05$), suggesting a compensatory angiogenic response following myocardial infarction; compared with the model group, MVC and MVD were significantly higher in Shexiang Baoxin Pill group and all dose groups of Zhuang Medicine Longzuan Tongbi Decoction, with statistically significant differences ($p < 0.05$), indicating that drug intervention can enhance the angiogenis in ischemic myocardium; compared with Shexiang Baoxin Pill group, MVC and MVD were significantly elevated in the high- and medium-dose groups of Zhuang Medicine Longzuan Tongbi Decoction ($p < 0.05$), whereas there was no statistically significant difference in MVC and MVD between the low-dose group of Zhuang Medicine Longzuan Tongbi Decoction and Baoxin Tongbi Pill group ($p > 0.05$); suggesting that the angiogenic effect of the Zhuang Medicine Longzuan Tongbi Decoction is dose-dependent, with superior efficacy at high and medium doses. Detailed data are shown in **Table 2**.

Table 2. Comparison of MVC and MVD in the MI border zone across groups ($\overline{x} \pm s$, $n = 20$）

Group	N	MVC, MVD
Normal control group	20	44.17 ± 2.53
Model group	20	59.32 ± 10.87
Shexiang Baoxin pill group	20	78.26 ± 9.35
Low-dose group of Zhuang medicine Longzuan Tongbi Decoction	20	79.05 ± 7.58
Medium-dose group of Zhuang medicine Longzuan Tongbi Decoction	20	85.42 ± 4.96
High-dose group of Zhuang medicine Longzuan Tongbi Decoction	20	86.13 ± 5.97

Note: Compared with the normal control group, (1) $p < 0.05$; compared with the model group, (2) $p < 0.05$; compared with the Shexiang Baoxin Pill group, (3) $p > 0.05$

5. Discussion

Coronary heart disease falls into the category of "Amen" in Zhuang medicine. It refers to a condition characterized by sudden precordial pain (which may radiate to the shoulder and back), dyspnea, and inability to lie flat, resulting from blockage of the Longlu (blood circulation vessel in Zhuang medicine). From the perspective of Zhuang medicine, the onset of "Amen" is attributed to the invasion of pathogenic factors such as wind, dampness, filth, and miasma, or to constitutional weakness and stagnation of qi and blood, resulting in obstruction of the Longlu and Huolu (sensory-conduction vessel of Zhuang medicine) [4].

Longzuan Tongbi Decoction is an empirical formula developed by our research team based on the Zhuang medicine therapeutic principle "removing toxins and unblocking vessels," and drawing upon traditional Zhuang folk herbal remedies for coronary heart disease. It consists of ten medicinal herbs, including *Radix Toddaliae Asiaticae* (Feilongzhangxue), *Radix Kadsurea Coccineae* (Dazuan), *Radix Alangii Chinensis* (Bajiaofeng), *Radix Zanthoxyli* (Liangmianzhen), *Caulis Sinomenii* (Qingfengteng), *Rhizoma Smilacis Glabrae* (Tufuling), *Caulis Spatholobi* (Jixueteng), *Herba Plantaginis* (Cheqiancao), *Rhizoma Dioscoreae Hypoglaucae* (Bixie) and *Pseudobulbus Cremastrae seu Pleiones* (Shancigu). According to Zhuang medicine theories, the onset of coronary heart disease is closely associated with stasis and stagnation of the Longlu and Huolu. Its core pathogenesis is "the mutual entanglement of toxins and stasis, and obstruction of the Qi pathway," leading to a disruption in the synchronized circulation of the three primordial Qi of heaven, human, and earth. This formula acts on the network of connections where the Longlu and Huolu intersect at the body's surface to unblock vessels, eliminate pathogenic factors, and restore the synchronized circulation of the three Qi, thereby exerting its therapeutic effects.

In this formula, *Radix Toddaliae Asiaticae* (Feilongzhangxue) serves as the monarch herb [5]. It can dissipate stasis, stop bleeding, remove toxins, and unblock collaterals, directly targeting the core pathogenesis of toxin-stasis obstructing collaterals, which aligns with the key therapeutic principle of "unblocking stasis in Longlu" in Zhuang medicine. *Radix Kadsurea Coccineae* (Dazuan) and *Caulis Spatholobi* (Jixueteng) act as minister herbs. *Radix Kadsurea Coccineae* (Dazuan) promotes Qi movement, activates blood circulation, unblocks collaterals, and relieves pain. It reinforces the stasis-dissipating effect of the monarch herb. Following the theory that free flow of Qi ensures unobstructed blood circulation, it ameliorates Qi stagnation in the Longlu and Huolu. *Caulis Spatholobi* (Jixueteng) tonifies and activates blood, unblocks collaterals, and relaxes tendons [6]. It remedies blood deficiency in the pattern of Qi deficiency and blood stasis, and prevents damage to healthy Qi caused by excessive stasis dissipation. *Radix Alangii Chinensis* (Bajiaofeng), *Radix Zanthoxyli* (Liangmianzhen), *Caulis Sinomenii* (Qingfengteng), *Rhizoma Smilacis Glabrae* (Tufuling) and *Rhizoma Dioscoreae Hypoglaucae* (Bixie) are designated as adjuvant herbs. *Radix Alangii Chinensis* (Bajiaofeng) dispels wind, eliminates dampness, dissipates stasis and unblocks collaterals, targeting the accompanying pattern of damp-toxin combined with stasis. *Radix Zanthoxyli* (Liangmianzhen) activates blood circulation, dissipates stasis, removes toxins and relieves swelling, further potentiating the detoxifying and stasis-resolving effects of the monarch herb. The combined use of *Caulis Sinomenii* (Qingfengteng), *Rhizoma Smilacis Glabrae* (Tufuling) and *Rhizoma Dioscoreae Hypoglaucae* (Bixie) clears heat and drains dampness, dispels wind and relieves impediment. They eliminate damp-toxin and heat-toxin, unblock stagnated collaterals, and relieve internal accumulation of phlegm-dampness commonly seen in patients with coronary heart disease. *Herba Plantaginis* (Cheqiancao) and *Pseudobulbus Cremastrae seu Pleiones* (Shancigu) function as guide herbs. *Herba Plantaginis* (Cheqiancao) clears heat, promotes diuresis, and

guides pathogenic toxins downward, facilitating the excretion of toxins from the lower jiao. *Pseudobulbus Cremastrae seu Pleiones* (Shancigu) clears heat, removes toxins, dissipates abscesses and resolves masses. It enhances the overall detoxifying effect of the formula, moderates the harsh properties of *Radix Alangii Chinensis* (Bajiaofeng) and *Radix Zanthoxyli* (Liangmianzhen), and harmonizes all medicinal ingredients. The whole formula exerts the combined effects of removing toxins and dissipating stasis, promoting Qi movement and unblocking collaterals, and regulating both Qi and blood. It conforms to the traditional Chinese medicine therapeutic strategy of tonifying Qi, activating blood, removing toxins and unblocking collaterals, as well as the Zhuang medicine theory of unblocking the Longlu and Huolu and restoring synchronous movement of the three Qi. With simultaneous treatment of root cause and manifestations and balanced regulation of cold and heat nature, this formula is applicable to coronary heart disease (chest impediment and heart pain) manifested as the pattern of Qi deficiency and blood stasis accompanied by toxin-stasis obstructing collaterals.

Angiogenesis is a critical process in the repair of ischemic myocardium; it promotes the survival, proliferation, and lumen formation of endothelial cells, and the synergistic action of these processes accelerates the formation of a new vascular network in the ischemic region. The results of this study showed that all dose groups of Zhuang Medicine Longzuan Tongbi Decoction significantly reduced the infarct size and increased MVC and MVD in the MI border zone in rats. It suggests that Zhuang Medicine Longzuan Tongbi Decoction exerts a protective effect on ischemic myocardium, promotes local angiogenesis in the ischemic myocardium, and improves myocardial blood supply.

6. Conclusion

In summary, Longzuan Tongbi Decoction effectively reduces myocardial infarct size and promotes angiogenesis in the ischemic myocardium of rats after MI, as evidenced by increased microvascular count and density in the infarct border zone. These cardioprotective effects exhibit a dose-dependent relationship, with the medium and high doses demonstrating superior pro-angiogenic efficacy compared to the positive control Shexiang Baoxin Pill. Our findings suggest that Longzuan Tongbi Decoction, formulated under the Zhuang medical principle of “detoxifying and unblocking vessels”, holds promise as a potential therapeutic agent for improving myocardial perfusion and limiting infarct expansion. Further studies are warranted to elucidate its underlying molecular mechanisms and signaling pathways.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhao K, Shen X, Liu H, et al., 2024, Somatic and Germline Variants and Coronary Heart Disease in a Chinese Population. JAMA Cardiology, 9(3): 233–242.

[2] Dong Q, Li Z, Ji Q, et al., 2023, Editorial: Inflammatory Factors in Coronary Heart Disease: Mechanism, Diagnosis, and Therapy. Frontiers in Cardiovascular Medicine, 10: 1234132.

[3] Zou Y, Xu Z, Su G, 2006, Laboratory Animal Science [M]. Beijing: Science Press: 122.

[4] Xu W, Qin Z, Yang Q, et al., 2023, Treatment of Anxiety Disorders Based on the "Three Tracts and Two Vessels" Theory of Zhuang Medicine. Western Journal of Traditional Chinese Medicine, 36(03): 91–95.

[5] Li J, Liu M, 2025, Mechanism of Radix Toddaliae Asiaticae in the Treatment of Ischemic Stroke Based on Network Pharmacology. China's Naturopathy, 33(12): 61–64.

[6] Li T, Wang Y, Xu X, et al., 2024, Lv Peiwen's Experience in Treating Arteriosclerosis Obliterans of Lower Extremity with Caulis Spatholobi. Beijing Journal of Traditional Chinese Medicine, 43(08): 886–889.

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Research Progress on the Application of AI Posture Recognition Technology in Traditional Chinese Medicine Exercise Intervention

Jiehui Li[1], Zhixia Zhang[1], Zhen Song[1], Jinghan Yin[2]

[1]Shandong Institute of Commerce and Technology, Jinan 250300, Shandong, China
[2]School of Medical and Health, Linyi Vocational College, Linyi 276017, Shandong, China

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Abstract: Traditional Chinese medicine (TCM) traditional exercises serve as an important carrier of the TCM "preventive treatment of disease" system and integrated physical and medical health services. They possess unique advantages in adolescent physical fitness improvement, sub-health regulation, chronic disease prevention and control, as well as rehabilitation medicine. For a long time, traditional Chinese medicine exercises have been plagued by problems such as difficulty in quantifying movement specifications, teaching relying on oral instruction and personal demonstration, lack of real-time feedback in the intervention process, and insufficient personalization, which restrict their modernization, large-scale and standardized popularization, and application. Represented by OpenPose, AI posture recognition technology features non-contact performance, real-time capability, high precision, and low cost, providing key technical support for the digital transformation of traditional Chinese medicine exercises. This paper systematically sorts out the research context and cutting-edge achievements of AI posture recognition in the field of traditional Chinese medicine exercise intervention, summarizes the technical integration paths and application modes, analyzes practical effects, and explores the core bottlenecks, including the transformation of TCM tacit knowledge, algorithm robustness, construction of standard systems, and long-term exercise adherence. It also prospects the future development trend of the integration of AI and traditional Chinese medicine exercises, aiming to provide a theoretical reference and academic basis for subsequent research, technology implementation, and achievement promotion in this field.

Keywords: AI posture recognition; Traditional Chinese medicine exercises; Integration of physical education and medical care; Digital intervention; Movement quantification; Precise health management; Adolescent physical fitness

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1. Introduction

Traditional Chinese medicine culture is a brilliant treasure of Chinese civilization. Typical traditional Chinese medicine exercises include Baduanjin, Wuqinxi, Tai Chi, and Yijinjing. Centering on the core principles of regulating the body, regulating breath, and regulating mind, they integrate physical fitness, emotional

regulation, rehabilitation, and health preservation, as well as cultural inheritance, and are unique non-drug health intervention methods in China. In recent years, with the in-depth implementation of the Healthy China Strategy, the continuous advancement of the 14th Five-Year Plan for the Development of Traditional Chinese Medicine, and the full implementation of policies on the integration of sports with medical care and sports with education, traditional Chinese medicine exercises have gradually entered campuses, communities and families, becoming an important means to address public health problems such as the decline of adolescent physical fitness, high prevalence of sub-health and the younger onset of chronic diseases.

In the process of practical promotion, the limitations of the traditional Chinese medicine exercise intervention model have become increasingly prominent. First, most movement essentials are expressed in empirical and literary descriptions, lacking objective and quantifiable evaluation criteria. Second, teaching relies heavily on manual guidance, making it difficult to ensure movement consistency in large-scale popularization. Third, most intervention plans adopt a one-size-fits-all model with insufficient personalized design for people of different ages and physical constitutions and postural problems. Fourth, there is a lack of real-time supervision and error correction mechanisms during practice; long-term accumulation of incorrect movements may reduce the intervention effect and even cause physical discomfort. Fifth, the effect evaluation mainly relies on subjective perception and observational judgment, which is insufficient in scientificity, objectivity, and persuasiveness. The above problems jointly result in the failure to fully release the health value of traditional Chinese medicine exercises and make it difficult to adapt to the development needs of modern, precise health services.

The rapid development of artificial intelligence and computer vision technology has provided a new way to solve the above dilemmas. Human posture recognition technology can realize quantitative analysis of limb posture and motion trajectory, as well as movement quality, through real-time detection and tracking of key skeletal points. Among them, algorithm models represented by OpenPose, HRNet, and ST-GCN are highly mature and applicable, and have been widely used in motion analysis, rehabilitation assessment, and movement teaching. AI posture recognition boasts the advantages of non-contact collection, real-time feedback, objective quantification, and low deployment cost. It can transform abstract exercise essentials such as keeping the head elevated and relaxed, sinking shoulders and dropping elbows, as well as chest containment and back stretching into computable, monitorable, and evaluable digital indicators. It provides crucial support for the transformation of traditional Chinese medicine exercises from experience-driven mode to data-driven mode, from universal popularization to individual precision intervention, and from result evaluation to process intervention.

At present, interdisciplinary research on AI posture recognition and traditional Chinese medicine exercises has become a cutting-edge topic attracting joint attention in sports science, traditional Chinese medicine, computer science, and preventive medicine. Focusing on the theme of AI posture recognition plus traditional Chinese medicine exercises, this paper comprehensively reviews domestic and foreign research progress in this field, summarizes technical integration paths and application scenarios and core achievements, analyzes existing problems and challenges, and prospects future development directions, so as to provide a systematic reference for academic research and achievement transformation.

2. Theoretical and technical basis for the integration of AI posture recognition and traditional Chinese medicine exercises

2.1. Health value and practical limitations of traditional Chinese medicine exercises

Traditional Chinese medicine exercises are rooted in the holistic concept and the ideology of preventive treatment of disease in TCM. They emphasize the harmony of physique and spirit, the balance of motion and stillness, and internal and external cultivation. Different from modern high-intensity competitive sports, traditional Chinese medicine exercises feature gentle movements, stable rhythm, and high safety, and are suitable for long-term practice by adolescents, middle-aged and older adults, rehabilitation groups, and people with weak physical constitutions. Modern studies have confirmed that traditional exercises such as Baduanjin and Tai Chi can effectively improve cardiopulmonary function, enhance muscle strength and joint flexibility, regulate autonomic nerves, relieve anxiety and depression, and correct abnormal postures. They exert multi-target and comprehensive intervention effects on adolescent myopia, obesity, scoliosis, neck, shoulder, waist, and leg pain, and other common health problems [1].

The intervention effect of traditional Chinese medicine exercises is highly dependent on movement standardization, while their core essentials are mostly passed down by personal teaching and verbal instruction, making it difficult to convey accurately through written language and set unified standards. In scenarios such as campus promotion, community popularization, and home practice, prominent practical problems, including insufficient professional guidance resources and difficulty in real-time correction of movement deviations, as well as difficulty in quantitative evaluation of intervention effects, restrict the large-scale, standardized, and precise application of traditional Chinese medicine exercises.

2.2. Core advantages and applicability of AI posture recognition technology

Human posture recognition is an important research direction in the field of computer vision. It realizes the quantitative expression of limb posture, motion trajectory, and movement quality by locating and tracking key human skeletal points. The mainstream technical routes are divided into two-dimensional posture estimation and three-dimensional posture estimation. Among them, OpenPose is the most mature two-dimensional posture recognition technology, which can output more than 17 key points in real time, support multi-person recognition and cross-platform deployment, as well as mobile terminal operation. It has the advantages of a small calculation amount, low deployment cost, and strong scene adaptability. Three-dimensional posture recognition can reconstruct three-dimensional spatial posture with the help of depth cameras or multi-view vision, and has higher accuracy in evaluating joint angles and spinal posture as well as body symmetry, which is applicable to professional rehabilitation assessment and laboratory research.

AI posture recognition is highly compatible with traditional Chinese medicine exercises. First, non-contact collection does not change the original exercise form and does not increase physical burden, which is non-invasive and easily accepted by users. Second, it has strong real-time performance and can complete posture evaluation and error correction feedback during exercise in real time. Third, it has outstanding quantification capability and can transform abstract exercise essentials into objective indicators such as joint angle, symmetry, stability, and trajectory smoothness. Fourth, it has low deployment requirements and can be realized with ordinary cameras and intelligent terminals, which makes it easy for large-scale popularization in campuses, communities, and families. Fifth, it can track individual posture changes for a long time to form continuous health files, providing data support for precise intervention and effect evaluation as well as long-term management.

2.3. Core logic of technical integration

The in-depth integration of AI posture recognition and traditional Chinese medicine exercises is essentially the digitalization and objectification, as well as standardization of traditional empirical knowledge. Its core logic lies in capturing human motion information through computer vision, analyzing traditional Chinese medicine movement specifications with data models, improving teaching and intervention efficiency through intelligent feedback, and optimizing intervention schemes with personalized algorithms, so as to finally realize the systematic upgrading of traditional Chinese medicine exercise intervention modes. This integration path not only retains the cultural connotation and health value of traditional Chinese medicine exercises, but also injects the precision and efficiency as well as accessibility of modern technology, which meets the dual requirements of inheritance and innovation of traditional Chinese medicine and the construction of digital health.

3. Research and application progress of AI posture recognition in traditional Chinese medicine exercise intervention

In recent years, extensive explorations have been carried out at home and abroad on the application of AI posture recognition in traditional Chinese medicine exercises. The research covers multiple dimensions, including movement digitization, quantitative evaluation, real-time feedback, personalized prescription, and health intervention, as well as campus popularization. A relatively complete technical system and application system have gradually taken shape, showing an overall development trend from technical verification to scenario implementation, from single function to system integration, and from laboratory research to large-scale application [2].

3.1. Research on digitization and standardization of traditional Chinese medicine exercises

Movement standardization is the premise of the large-scale popularization of traditional Chinese medicine exercises. Existing research generally takes posture recognition technology as the core tool to build digital standards. By collecting standard movement data of professional coaches and intangible cultural heritage inheritors, researchers extract key skeletal points, joint angles, motion trajectories, and time sequence features, and transform traditional empirical essentials into computable and reproducible as well as comparable digital models. In the research on mainstream exercises such as Baduanjin, Tai Chi, and Wuqinxi, researchers focus on marking and analyzing the starting form, ending form, and core single movements, and build standard movement databases and typical wrong movement sample databases. Some studies further combine the Delphi method and expert consultation method to determine the movement threshold values and standard ranges for people of different ages and physical constitutions, providing a scientific basis for intelligent evaluation systems. The establishment of digital standards has transformed the traditional teaching mode relying on oral instruction and personal demonstration into a data-based and standardized one, laying a foundation for large-scale popularization [3].

3.2. Research on intelligent evaluation and quantitative assessment of movement quality

Movement quality evaluation is the most mature and widely applied direction of AI posture recognition. Based on key point data, existing research constructs comprehensive evaluation models from dimensions

such as static posture, dynamic trajectory, and body symmetry, as well as motion stability, so as to automatically score movement completion and standardization degree. Static evaluation focuses on postural features such as joint angle, trunk verticality, and limb symmetry. Dynamic evaluation analyzes movement fluency and rhythm consistency as well as trajectory smoothness, combined with time sequence information. Comprehensive evaluation integrates multi-dimensional indicators to form a weighted scoring model, which can be applied to teaching assessment, self-monitoring, and competition judgment. A large number of experimental results show that the evaluation results based on AI are highly consistent with professional coaches' scoring, which can effectively replace manual evaluation and improve the objectivity and fairness as well as efficiency of evaluation, providing a new means for the scientific assessment of traditional Chinese medicine exercises.

3.3. Research and application of real-time feedback and intelligent guidance system

Real-time feedback is the key link to improving intervention effects and reducing the occurrence of wrong movements. Existing research generally adopts visual interface, virtual coach, voice prompt, and deviation marking methods to point out wrong parts in real time during exercise and give adjustment suggestions, realizing immersive guidance of correcting movements while practicing. Visual feedback intuitively presents posture deviation by overlaying the standard skeleton and real-time skeleton comparison. Voice guidance uses simple instructions to guide practitioners to adjust their posture quickly. Some studies introduce AR/VR technology to enhance interactive immersion and improve exercise interest and adherence. In scenarios such as campus physical education, home fitness, and rehabilitation training, the real-time feedback system can significantly improve movement standardization, make up for the shortage of professional instructors, and promote the intelligent and personalized upgrading of traditional Chinese medicine exercise teaching.

3.4. Exploration of personalized exercise prescription and dynamic intervention mode

Personalization is the core requirement of precise health management, and it is also an important embodiment of empowering traditional Chinese medicine exercises with AI technology. Based on the quantitative evaluation results of AI posture recognition, researchers have gradually constructed a closed-loop intervention mode of physical portrait–problem identification–prescription generation–effect tracking–dynamic adjustment. The system automatically recommends exercise combinations, training intensity, exercise frequency, and intervention cycle according to practitioners' age, physical posture problems, exercise ability, and practice progress, realizing a precise one-person-one-prescription intervention. Aiming at adolescent typical problems such as scoliosis, round shoulder, and humpback as well as obesity and low physical fitness, personalized prescriptions focus on strengthening core control, spinal stretching, limb symmetry, and whole-body rhythm training, and gradually advance with the improvement of physical conditions, breaking the limitations of the traditional one-size-fits-all intervention mode [4].

4. Main problems and challenges in current research

Although remarkable progress has been made in the integration of AI posture recognition and traditional Chinese medicine exercises, there are still in-depth problems and challenges restricting the high-quality development from theoretical construction, technical implementation, and clinical demonstration to large-scale popularization.

First, the digital transformation of traditional Chinese medicine tacit knowledge is insufficient. Traditional Chinese medicine exercises emphasize the integration of mind, breath, and body. Connotations such as breath regulation, mental concentration, force application, and internal Qi circulation are difficult to express through external skeletal point data fully. Existing technologies mostly stay at the quantification level of physical form, and the digital analysis of Qi and spirit is still in the initial exploration stage, failing to fully restore the core mechanism of traditional Chinese medicine exercises [5].

Second, algorithm robustness and real scene adaptability are limited. In real application scenarios such as complex light, limb occlusion, loose clothing, shooting angle change, and multi-person simultaneous presence, posture recognition accuracy is vulnerable to interference. Adolescents have large physical development differences and variable movement amplitude and rhythm, and the generalization ability and stability of general models still need further improvement.

Third, the industrial standard and evaluation system have not been unified. Different studies adopt different key points, evaluation indicators, threshold ranges, and scoring models, lacking nationally unified technical standards, data standards, and evaluation specifications, resulting in difficulty in horizontal comparison and reuse, as well as large-scale popularization of research achievements.

Fourth, personalized design and long-term adherence need to be further strengthened. Most systems focus on error correction and guidance, lacking gamification, incentive mechanisms, social interaction, and growth system design to improve adherence, making it difficult to maintain adolescents' long-term exercise interest. Adaptive dynamic prescription algorithms are still relatively simple, and it is still difficult to realize accurate iteration of personalized prescriptions for different individuals.

5. Future development trends and research prospects

Facing the strategies of Healthy China, Digital China, and the inheritance and innovation of traditional Chinese medicine, the integration of AI posture recognition and traditional Chinese medicine exercises will continue to develop towards greater intelligence, standardization, universality, clinical relevance, and cultural connotation. The following research directions are worthy of attention in the future.

First, promote the in-depth integration of the TCM mechanism and multi-modal data. Break the limitation of simple external posture recognition, integrate breathing, heart rate, infrared thermal imaging, electromyography, and TCM syndrome information, and build an integrated evaluation model of physique-breath-spirit, which is closer to the essence of TCM health preservation and improves the theoretical depth and clinical persuasiveness.

Second, construct a unified standard system and shared data sets. Accelerate the formulation of industrial standards for AI recognition and quantitative evaluation, as well as movement specifications and data interfaces of traditional Chinese medicine exercises, and establish publicly shared high-quality labeled data sets to promote the standardization and replicable popularization of technological achievements.

Third, develop lightweight and highly robust edge algorithms. Optimize the deployment efficiency of mobile terminals, improve the adaptability in complex scenarios, realize instant use on mobile phones, tablets, and smart TVs, reduce the popularization threshold, and achieve full coverage in campuses and families.

Fourth, strengthen personalized and gamified interactive design. Combine the behavioral characteristics

of adolescents, integrate the task system, point incentive, virtual image, and social interaction elements to improve long-term adherence. Build an adaptive dynamic prescription engine based on big data and large models to realize full-cycle, precise intervention.

6. Conclusion

AI posture recognition technology provides key support for the modernization, standardization, and precision of traditional Chinese medicine exercises. It has made important progress in movement digitization, quantitative evaluation, real-time feedback, personalized prescription, adolescent health promotion, and rehabilitation medical treatment. It effectively solves the core bottlenecks of inconsistent standards, insufficient personalization, delayed feedback, and difficult effect evaluation in traditional intervention modes, providing a feasible path for the inheritance and innovation of traditional Chinese medicine and the construction of digital health. At present, this field is developing from technical exploration to application implementation, from single posture recognition to multi-modal integration, and from manual guidance to intelligent closed-loop intervention, showing great health value, educational value, social value, and cultural value. At the same time, the development of this field still faces practical challenges such as the transformation of TCM tacit knowledge, algorithm robustness, standard system construction, and exercise adherence, as well as empirical evidence. In the future, it is necessary to strengthen interdisciplinary integration, technical optimization, and standard construction as well as empirical research, so as to promote the in-depth integration of AI and traditional Chinese medicine exercises, and make it an important force serving adolescent physical health, national health promotion, and inheritance and innovation of traditional Chinese medicine, and provide Chinese solutions for global health governance.

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References

[1] State Council of the People’s Republic of China, 2022, The 14th Five-Year Plan for Traditional Chinese Medicine Development.

[2] Ministry of Education, General Administration of Sport of China, National Health Commission, 2021, Action Plan for Youth Health Promotion Through Integration of Sports and Education (2021–2025).

[3] Cao Z, Hidalgo G, Simon T, et al., 2019, OpenPose: Realtime Multi-Person 2D Pose Estimation Using Part Affinity Fields. IEEE Transactions on Pattern Analysis and Machine Intelligence, 43(1): 172–185.

[4] Ministry of Education, 2021, National Survey Results on Students' Physical Fitness and Health in 2019. Chinese Journal of School Health, 42(8): 1121–1125.

[5] Liu X, Wang X, 2021, Meta-Analysis on the Effect of Baduanjin on Adolescent Physical Fitness. Chinese Journal of Rehabilitation Medicine, 36(7): 832–838.

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Application Research on Hemodynamic and Metabolic Abnormalities in Patients with Subclinical Hypothyroidism

Juan Luo, Jiaqi Chen, Jingfeng Li, Nengwen Lin

Loudi Central Hospital, Loudi 417000, Hunan, China

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Abstract: Objective: To explore the clinical application value of abnormal hemodynamic and metabolic indicators in patients with subclinical hypothyroidism (SCH), and to provide clinical evidence for early intervention of SCH and prevention of cardiovascular complications. Methods: A total of 40 SCH patients were enrolled as the study group (Group 1), and another 40 subjects with normal thyroid function were selected as the control group (Group 0). General clinical data (gender, age, height, weight) and hemodynamic indicators (epicardial adipose tissue thickness, aortic pulse wave velocity, carotid intima-media thickness) were collected, respectively. The differences of each indicator between the two groups were compared, and the correlation among indicators was analyzed by statistical methods. Results: The thickness of epicardial adipose tissue and carotid intima-media thickness in the study group were significantly higher than those in the control group ($p < 0.05$), while the aortic pulse wave velocity was significantly lower ($p < 0.05$). The body mass index (BMI) of the study group was higher than that of the control group, with more middle-aged and older adults and a higher female proportion. Conclusion: SCH patients present obvious hemodynamic disturbance and metabolic imbalance. Epicardial adipose tissue thickness, aortic pulse wave velocity, and carotid intima-media thickness can be used as indicators to evaluate cardiovascular risk in SCH patients. Early monitoring and intervention of the above indicators are beneficial for improving patients' prognosis.

Keywords: Subclinical hypothyroidism; Hemodynamics; Metabolic abnormalities

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1. Introduction

Subclinical hypothyroidism (SCH) is an endocrine and metabolic disorder characterized by elevated serum thyroid-stimulating hormone (TSH) levels, normal serum free thyroxine (FT4) levels, and the absence of typical clinical manifestations of hypothyroidism. In recent years, with the development of thyroid function detection technology, the detection rate of SCH has increased year by year. The prevalence rate in the general population ranges from 4% to 10%, rising with age and positive thyroid autoantibodies, and the prevalence in

females is significantly higher than that in males [1].

Although SCH has no obvious clinical symptoms, long-term mild thyroid dysfunction can affect body metabolism and blood circulation through multiple pathways, resulting in a series of health problems. Existing studies have shown that SCH is associated with lipid metabolic disorder, atherosclerosis, and cardiovascular diseases. The potential mechanism is that elevated TSH impairs vascular endothelial function, enhances oxidative stress, and increases low-density lipoprotein synthesis, thereby causing hemodynamic abnormalities and metabolic imbalance, and increasing the risk of coronary heart disease, heart failure, and other cardiovascular events [2].

Hemodynamic indicators are non-invasive parameters for evaluating vascular lesions and cardiac structure and function. Increased carotid intima-media thickness is an early marker of atherosclerosis; increased epicardial adipose tissue thickness is related to abnormal cardiac metabolism; decreased aortic pulse wave velocity suggests reduced vascular elasticity [3].

2. Materials and methods

2.1. Research subjects

From August 2020 to August 2023, 40 inpatients and outpatients diagnosed with SCH in our hospital were selected as the experimental group (Group 1), and 40 healthy subjects with normal thyroid function undergoing physical examination during the same period were enrolled as the control group (Group 0). All participants signed informed consent, and this study was approved by the Ethics Committee of Loudi Central Hospital [4].

Inclusion criteria: Meeting the diagnostic criteria of SCH; serum TSH > 6.8 mIU/L; FT4 within the normal reference range; no typical hypothyroidism symptoms such as fatigue, cold intolerance, and weight gain. Referring to the 2023 clinical guidelines of the Korean Thyroid Association, patients with a personal or family history of thyroid diseases were excluded [5].

General baseline data of the two groups: Study group (Group 1): 28 females and 12 males; aged 18–45 years, mean age (36.8 ± 7.2) years; height 157–175 cm, mean (161.3 ± 5.8) cm; weight 47–70 kg, mean (56.9 ± 6.3) kg. Control group (Group 0): 26 females and 14 males; aged 22–47 years, mean age (35.6 ± 8.1) years; height 158–175 cm, mean (162.5 ± 6.1) cm; weight 48–65 kg, mean (55.7 ± 5.9) kg [6].

There was no significant difference in general data (gender, age, height, weight) between the two groups ($p > 0.05$), indicating comparable baseline conditions.

2.2. Research methods

First, general data collection: Electronic medical records and physical examination reports were used to collect gender, age, height, weight, outpatient number, and follow-up times. BMI was calculated as:

BMI = weight (kg) / height squared (m^2).

Second, hemodynamic index detection: All subjects were examined under a fasting state after 30 minutes of quiet rest, without strenuous exercise, emotional fluctuation, smoking, or drinking. Qualified sonographers performed color Doppler ultrasonography. Epicardial adipose tissue thickness: measured at end-diastole in parasternal long-axis view, averaged from 3 measuring points; Aortic pulse wave velocity: averaged from three measurements of ascending aortic blood flow velocity; Carotid intima-media thickness: averaged from 1–2 cm proximal to the bifurcation of bilateral common carotid arteries [7].

All detections were performed in strict accordance with ultrasonic specifications to ensure accuracy.

Third, thyroid function detection: Fasting venous blood 5 mL was collected, and serum was separated after centrifugation. Serum TSH and FT4 levels were determined by chemiluminescence immunoassay. Instruments and reagents met clinical standards, and operations followed manufacturer instructions strictly to ensure reliable results [8].

2.3. Statistical methods

SPSS 26.0 statistical software was adopted for data analysis. Measurement data were expressed as mean ± standard deviation ($\overline{x} \pm s$), and an independent sample t-test was used for inter-group comparison; enumeration data were expressed as percentage (%), and a Chi-square (χ^2) test was applied; Pearson correlation analysis was used for correlation analysis. $p < 0.05$ was considered statistically significant [9].

3. Results

3.1. Comparison of thyroid function indicators between two groups

The serum TSH level of the study group was significantly higher than that of the control group, while FT4 was significantly lower ($p < 0.05$), consistent with SCH diagnostic criteria.

Study group: TSH (8.92 ± 2.15) mIU/L, FT4 (11.25 ± 1.36) pmol/L;

Control group: TSH (3.85 ± 1.02) mIU/L, FT4 (13.68 ± 1.52) pmol/L.

3.2. Comparison of hemodynamic indicators between two groups

The study group had significantly greater epicardial adipose tissue thickness and carotid intima-media thickness, and significantly lower aortic pulse wave velocity than the control group ($p < 0.001$) [10]. See Table 1.

Table 1. Comparison of hemodynamic indicators between two groups

Group	Case number	Epicardial adipose tissue thickness (cm)	Aortic pulse wave velocity (cm/s)	Carotid intima-media thickness (cm)
Study group (Group 1)	40	0.243 ± 0.058	42.85 ± 8.62	0.235 ± 0.061
Control group (Group 0)	40	0.201 ± 0.047	56.93 ± 9.15	0.138 ± 0.052
t value	—	3.825	-6.732	8.157
p value	—	< 0.001	< 0.001	< 0.001

3.3. Comparison of general metabolic indicators between two groups

The BMI of the study group was (21.8 ± 3.2) kg/m^2, significantly higher than (20.7 ± 2.8) kg/m^2 of the control group ($p < 0.05$).

In age distribution, the study group was mainly aged 35–45 years (65.0%, 26/40), while the control group was mainly aged 25–35 years (60.0%, 24/40). The female proportion was 70.0% (28/40) in the study group and 65.0% (26/40) in the control group. There was no statistical difference in gender and age distribution ($p > 0.05$), but the proportions of middle-aged and elderly population, as well as females, were slightly higher in the study group.

4. Discussion

SCH is an early stage of hypothyroidism, mainly characterized by elevated TSH and normal FT4 without typical clinical symptoms. Long-term mild thyroid dysfunction can affect metabolic level and hemodynamic stability, and increase the risk of cardiovascular diseases [11]. By comparing indicators between SCH patients and euthyroid subjects, this study confirmed obvious metabolic abnormalities and hemodynamic disturbances in SCH patients, which are consistent with previous research findings.

SCH patients had higher body weight and BMI, indicating that SCH is closely related to metabolic disorders. The possible mechanism is that elevated TSH reduces basal metabolic rate and energy consumption, and regulates adipocyte differentiation and lipid metabolism to cause fat accumulation, thus increasing BMI [12]. In addition, SCH is often accompanied by lipid metabolism disorder with elevated total cholesterol and triglyceride levels, which supports the elevated BMI result in this study and indicates that metabolic abnormality is an important feature of SCH associated with increased cardiovascular risk.

In terms of hemodynamic abnormalities, SCH patients showed increased epicardial adipose tissue thickness and carotid intima-media thickness, as well as decreased aortic pulse wave velocity, which were correlated with TSH levels. Epicardial adipose tissue can secrete inflammatory factors; its thickening is associated with cardiac metabolic disorder and inflammatory response, affecting myocardial blood supply, inducing cardiac hypofunction, and increasing heart failure risk [13]. Carotid intima-media thickness is an early sensitive marker of atherosclerosis. Elevated TSH upregulates inflammatory adhesion molecules in vascular endothelial cells, inhibits nitric oxide synthase activity, damages endothelial function, and accelerates atherosclerotic progression. Reduced aortic pulse wave velocity indicates decreased vascular elasticity and increased arterial stiffness, raising the risk of cardiovascular events.

Correlation analysis showed that TSH level was positively correlated with epicardial adipose tissue thickness and carotid intima-media thickness, and negatively correlated with aortic pulse wave velocity, suggesting that elevated TSH is one of the causes of hemodynamic abnormalities in SCH patients [14]. The underlying mechanism may be that increased TSH activates the sympathetic nervous system, raises vascular resistance, and reduces vascular elasticity; meanwhile, it triggers an inflammatory response and oxidative stress to damage endothelial function and alter hemodynamic indicators. Metabolic disorders such as fat accumulation induced by high TSH further affect hemodynamic stability, forming a vicious cycle.

Epidemiological studies show that SCH prevalence is higher in females and middle-aged/elderly populations, which is consistent with the demographic characteristics in this study. Regular monitoring of thyroid function and hemodynamic indicators should be strengthened for high-risk groups. It is also found that SCH patients with TSH > 10 mIU/L have significantly increased cardiovascular risk. The average TSH of the study group was 8.92 ± 2.15 mIU/L (mild SCH), but obvious hemodynamic abnormalities were already present, suggesting that early intervention is necessary even for mild SCH.

5. Conclusion

SCH patients are characterized by increased epicardial adipose tissue thickness and carotid intima-media thickness, decreased aortic pulse wave velocity, and higher BMI compared with euthyroid individuals. Serum TSH level is correlated with hemodynamic indicators and serves as an important influencing factor of hemodynamic stability in SCH patients [15].

Epicardial adipose tissue thickness, aortic pulse wave velocity, and carotid intima-media thickness can be used as non-invasive indicators to evaluate cardiovascular risk in SCH patients. Early monitoring of thyroid function and the above hemodynamic indicators, together with timely intervention on metabolic and hemodynamic abnormalities, can reduce cardiovascular complications and improve prognosis. Thyroid function screening should be carried out among high-risk populations such as females and middle-aged/older adults to realize early detection and intervention and improve clinical diagnosis and treatment efficacy.

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References

[1] Jiang Q, 2025, Therapeutic Effect of Levothyroxine in Subclinical Hypothyroidism Patients Complicated with Cardiovascular Diseases. Chinese Journal of Practical Medicine, 20(22): 90–92.

[2] Han X, 2025, Analysis of TCM Syndrome Elements and Prognostic Influence of Heart Failure with Preserved Ejection Fraction Complicated with Subclinical Hypothyroidism, thesis, Tianjin University of Traditional Chinese Medicine.

[3] Wang L, 2025, Correlation Study on Gut Microbiota Characteristics in Type 2 Diabetes Mellitus Combined with Subclinical Hypothyroidism, thesis, Ningxia Medical University.

[4] Zhang Y, 2024, Effects of Gestational Subclinical Hypothyroidism on Fetal Cardiac Function and Peripheral Vascular Hemodynamics, thesis, Kunming Medical University.

[5] Yi L, 2024, Clinical Study of Tongyuan Acupuncture on Pregnancy Outcome of Recurrent Implantation Failure Patients with Subclinical Hypothyroidism, thesis, Guangzhou University of Chinese Medicine.

[6] Zhang X, 2024, Lesion Characteristics and TCM Syndrome Features of Coronary Heart Disease Complicated with Subclinical Hypothyroidism, thesis, Tianjin University of Traditional Chinese Medicine.

[7] Zou J, 2024, Influence of Sleep Disorders on Bone Mineral Density in Patients With Subclinical Hypothyroidism, thesis, Lanzhou University.

[8] Hou L, 2023, Influence of TSH Level on Coronary Artery Lesions and Thromboembolic Events in Coronary Heart Disease Patients with Subclinical Hypothyroidism, thesis, Jining Medical University.

[9] Xi X, Hou T, Wang H, et al., 2022, Meta-Analysis of the Relationship Between Subclinical Hypothyroidism and Prognosis in Patients with Chronic Systolic Heart Failure. Clinical Focus, 37(10): 905–911.

[10] Zhang X, 2022, Treatment Strategy of Chronic Heart Failure Combined with Subclinical Hypothyroidism, thesis, Peking Union Medical College.

[11] Bai M, Muyesaier M, Liu H, et al., 2022, Relationship Between Subclinical Hypothyroidism and Central Aortic Pressure-Related Indices as Well as Pulse Wave Velocity in Essential Hypertension Patients. Journal of Clinical Cardiology, 38(04): 318–322.

[12] Liu Y, 2022, Influence of Subclinical Hypothyroidism on Prognosis and Risk Factors in Elderly Patients After Percutaneous Coronary Intervention, thesis, Hebei Medical University.

[13] Bai M, 2022, Correlation Between Subclinical Hypothyroidism and Central Aortic Pressure Indexes and Pulse Wave Velocity in Essential Hypertension Patients, thesis, Xinjiang Medical University.

[14] Zhou X, 2021, CCTA Study on Coronary Atherosclerotic Plaque Characteristics in Patients with Subclinical Hypothyroidism, thesis, Sichuan University.

[15] Yang Z, 2021, Influence of Subclinical Hypothyroidism on Acute Kidney Injury After Emergency Coronary Intervention in Patients with Acute Coronary Syndrome, thesis, Southeast University.

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Multimodal Treatment for Chronic Thromboembolic Pulmonary Hypertension: A Case Report

Yinjiang Tang, Ou Xu, Chunmei Zhang*

Department of Pulmonary Vascular and General Medicine, Fuwai Yunnan Cardiovascular Hospital, Yunnan Provincial Cardiovascular Disease Clinical Medical Center/Affiliated Cardiovascular Hospital of Kunming Medical University, Kunming 650000, Yunnan, China

Author to whom correspondence should be addressed.

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Abstract: Chronic thromboembolic pulmonary hypertension (CTEPH) is a severe disease characterized by pulmonary thromboembolism and vascular remodeling, the pathogenesis of which has not been fully elucidated. Currently, it is believed that the disease primarily originates from the shedding of thromboemboli from the right heart system, leading to mechanical obstruction of the pulmonary artery, which in turn triggers local inflammatory reactions, endothelial damage, and vascular remodeling. This results in elevated pulmonary artery pressure, ultimately leading to right heart failure. In recent years, a multimodal treatment strategy combining balloon pulmonary angioplasty (BPA) with targeted pharmacotherapy has demonstrated significant efficacy in the treatment of CTEPH. This article reports the diagnosis and treatment process of a 68-year-old female patient with CTEPH. After undergoing BPA combined with soluble guanylyl cyclase stimulators (riociguat), the patient's clinical symptoms and hemodynamic parameters significantly improved.

Keywords: Chronic thromboembolic pulmonary hypertension; Percutaneous ballon pulmonary angioplasty; Multimodal therapy; Riociguat

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1. Introduction

Chronic thromboembolic pulmonary hypertension (CTEPH) is a progressive and debilitating disease resulting from persistent pulmonary artery obstruction and vascular remodeling following acute pulmonary embolism [1–4]. If left untreated, it leads to increased pulmonary vascular resistance, right heart failure, and a poor prognosis. While pulmonary endarterectomy (PEA) remains the gold-standard treatment for proximal lesions, many patients with distal or peripheral disease are deemed inoperable. For these patients, multimodal

therapy combining balloon pulmonary angioplasty (BPA) and targeted pharmacotherapy, such as the soluble guanylyl cyclase stimulator riociguat, has emerged as an effective alternative. Here, we report the case of a 68-year-old female with inoperable CTEPH who demonstrated significant clinical and hemodynamic improvement following sequential BPA procedures and riociguat treatment.

2. Clinical data

The patient is a 68-year-old female farmer. Chief complaint: breathlessness after physical activity for 9 years. Admission date: September 2019.

The patient developed asthma after a sudden activity in 2010. Pulmonary artery enhancement CT scan (CTPA) revealed pulmonary embolism, and long-term anticoagulant therapy with "warfarin" was administered. In 2013, the patient was hospitalized at a certain hospital for right heart catheterization and pulmonary angiography. The results were as follows: right atrial pressure (RAP) 10/8/8 mmHg, pulmonary artery pressure (PAP) 92/27/50 mmHg, pulmonary artery wedge pressure (PAWP) 7 mmHg, cardiac output (CO) 3.4 L/min, pulmonary vascular resistance (PVR) 12.65 Wood units, and pulmonary angiography showed multiple segmental pulmonary artery stenosis, mainly in the left upper, right upper, and right lower lungs. The patient was treated with oral rivaroxaban 20 mg/day and sildenafil 25 mg, tid for long-term therapy, but there was no significant improvement in symptoms. Past medical history: history of lower limb venous thrombosis, without treatment.

Upon admission, physical examination revealed the following: T: 36.3 ℃, P: 85 beats/min, R: 20 beats/min, Bp: 105/62 mmHg, no cyanosis in lips, jugular vein engorgement, no wet rales heard in both pulmonary bases, heart rate 85 beats/min, regular rhythm, P2 accentuation, no enlargement of liver or spleen, mild non-pitting edema below the ankle joints in both lower limbs. Post-admission examinations, including blood routine, erythrocyte sedimentation rate, electrolytes, liver and kidney function tests, homocysteine, anti-streptolysin O, C-reactive protein, rheumatoid factor, immunoglobulin, thyroid function tests, interleukin-6, procalcitonin, troponin, stool routine, fibrinogen degradation products assay, D-dimer, and infectious markers, were all normal. N-terminal pro-B-type natriuretic peptide (NT-pro-BNP) was 417.00 pg/mL, and no abnormalities were found in the autoimmune vasculitis panel. Ultrasound of the veins in both lower limbs showed the formation of atherosclerotic plaques in both lower limbs, with a widened internal diameter of the left intermuscular vein. Pulmonary function tests revealed no significant abnormalities. Computed Tomography Angiography (CTPA) showed moderate to severe stenosis in the opening of the right upper lung and a few branches of the lower lung (**Figure 1**). Cardiac Magnetic Resonance Imaging (MRI) revealed a full right ventricular end-diastolic diameter (**Figure 2**), and Ventilation/Perfusion Imaging (VQ) showed a mismatch in V/Q in both lungs, with multiple subsegmental perfusion defects in both lungs, particularly evident in the right lung, consistent with pulmonary embolism changes (**Figure 3**). The 6-minute walking distance was 275 meters. Transthoracic echocardiography revealed a left atrial anteroposterior diameter (LA) of 37 mm, a left ventricular end-diastolic diameter (LV) of 48 mm, a right atrial (RA) anteroposterior and lateral diameters of 49 mm and 41 mm, respectively, and a right ventricular anteroposterior diameter (RV) of 28 mm. The estimated pulmonary artery systolic pressure was 92 mmHg, and the tricuspid valve systolic displacement was 19 mm. Ultrasound conclusion: severe pulmonary hypertension, with enlarged right atrium and right ventricle.



Figure 1. CTPA: Peripheral branches of the pulmonary artery are thin and occluded.



Figure 2. Cardiac MRI: The right ventricular diameter is full, with moderate to severe stenosis in the opening of some branches, particularly on the right side.

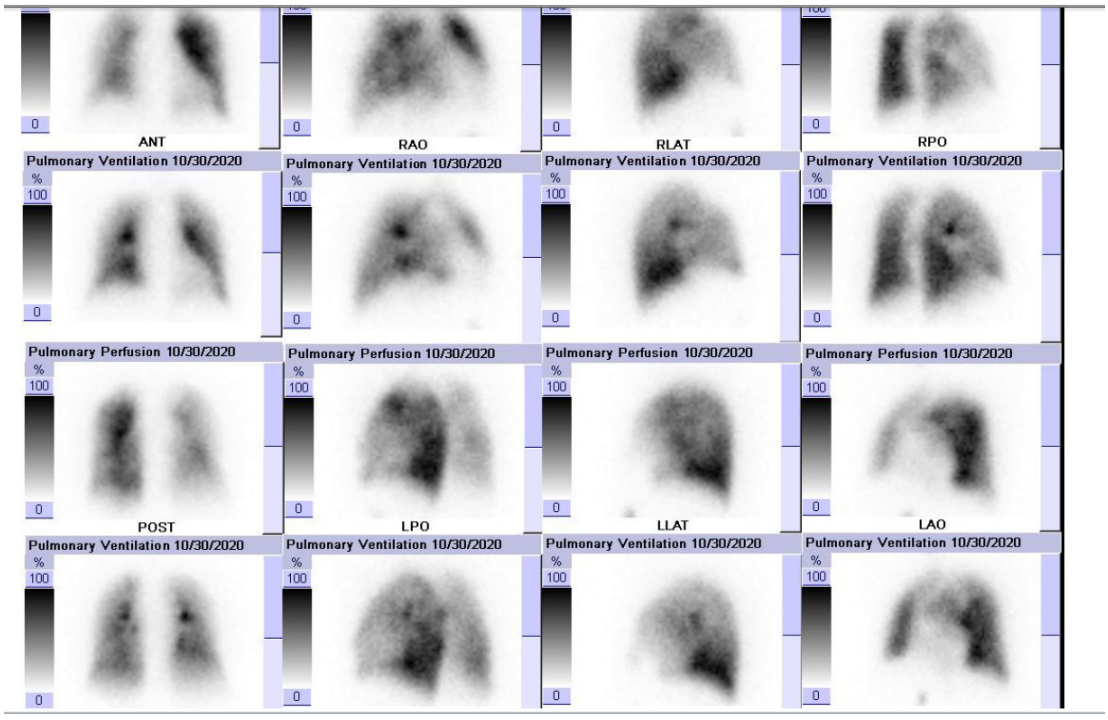


Figure 3. Lung perfusion: Bilateral pulmonary V/Q mismatch, multiple subsegmental impaired blood perfusion in both lungs, with marked impairment in the right lung.

After admission, right heart catheterization, pulmonary angiography, and percutaneous balloon pulmonary angioplasty were performed under local anesthesia. Details are as follows: RAP 10/8/8 mmHg, PAP 68/34/41 mmHg, PAWP 11 mmHg, CO 3.70 L/min, CI 2.1 L/min/m^2, PVR 8.92 Wood U, radial artery oxygen saturation 84.6%. Pulmonary angiography showed moderate to severe stenosis in the branch opening of the apical segment of the right upper lobe, severe stenosis in the opening of the internal and external basal segments of the right lower lobe, and severe stenosis in the posterior basal segment of the right lower lobe. Moderate stenosis in the middle segment of the inferior lingual artery of the left upper lobe, moderate to severe stenosis in the opening of the posterior pulmonary artery of the left lower lobe, moderate to severe stenosis in the lateral branch opening of the left lower lobe, and moderate to severe stenosis in the anterior pulmonary artery of the left lower lobe. Based on clinical history combined with right heart catheterization, the final diagnosis was chronic thromboembolic pulmonary hypertension, chronic pulmonary heart disease with cardiac enlargement, tricuspid insufficiency, and cardiac function class III (NYHA classification). After completing the right heart catheterization, BPA treatment was administered: balloon angioplasty was performed on the posterior pulmonary artery of the left lower lobe, the lateral branch of the left lower lobe, the inferior lingual artery of the left upper lobe, and the anterior pulmonary artery of the left lower lobe. Post-discharge treatment: oral administration of lioxapine 1 mg TID, gradually titrated to 2.5 mg TID, and rivaroxaban 20 mg/day.

The patient was admitted to the hospital again in October 2020 for another BPA procedure. The cardiac ultrasound examination revealed pulmonary hypertension, with a left atrial anteroposterior diameter of 40 mm, a left ventricular end-diastolic diameter of 41mm, a right atrial superior-inferior × lateral-medial diameter of 55 × 50 mm, a left atrial superior-inferior × lateral-medial diameter of 59 × 40 mm, and a right

ventricular anteroposterior diameter of 26 mm. TAPSE was 23 mm. On November 5, 2020, the patient underwent right heart catheterization, pulmonary angiography, and percutaneous pulmonary balloon dilatation. Details are as follows: RAP 15/14/13 mmHg, PAP 76/29/44 mmHg, PAWP 13 mmHg, CO 5.05 L/min, CI 2.94 L/min/m^2, PVR 6.14Wood U. Pulmonary angiography showed grid-like stenosis in the apical segment of the right upper lobe, grid and cord-like stenosis in the medial and lateral basal segments of the right lower lobe, and local annular stenosis in the posterior basal segment of the right lower lobe. Balloon dilatation was performed on the aforementioned vascular lesions. Post-procedure, the patient continued to take leosilva 1 mg TID and gradually titrated up to 2.5 mg TID, as well as rivaroxaban 20 mg/day. After half a year, a follow-up examination showed significant symptom relief, with NT-pro-BNP at 135.00 pg/mL and 6MWD at 410 meters.

3. Discussion

The pathogenesis of CTEPH is not fully understood. Most scholars believe that its main mechanism involves thrombosis obstructing the pulmonary artery, leading to abnormal blood flow. This process also involves pulmonary artery lumen remodeling and local inflammatory response after thromboembolism, ultimately resulting in right heart failure. For patients with CTEPH, if the thrombus is located in the pulmonary lobe or above the pulmonary segment, pulmonary endarterectomy (PEA) is the preferred treatment. However, for a thrombus located in the pulmonary subsegment or below the subsegment, PEA is not feasible. Multimodal therapy (BPA + medication) is the standard treatment for such cases of CTEPH. In this case, due to extensive peripheral pulmonary artery disease, PEA is not feasible, and fractional BPA has become the preferred treatment [5–10].

In this case, despite anticoagulant therapy, the patient's symptoms continued to progress. Through CTPA, VQ, and pulmonary angiography, combined with right heart catheterization, CTEPH was finally diagnosed. Before the second BPA treatment, a follow-up right heart catheterization was performed, and the mean pulmonary artery pressure (PAP) did not decrease. However, considering the clinical symptom improvement and the increase in 6-minute walking distance (6MWD) from 275 meters to 386 meters, as well as the decrease in pulmonary vascular resistance (PVR) from a baseline of 8.92 Wood U to 6.14 Wood U, it indicated that one BPA treatment could still reduce the right heart afterload. However, the pulmonary artery remained high. Six months after the second BPA procedure, the patient's clinical symptoms significantly improved (including endurance, NT-pro-BNP, and 6MWD), indicating that multimodal therapy (targeted drugs and two BPA procedures) had achieved significant clinical improvement in the patient.

4. Conclusion

This case study indicates that for CTEPH patients who are not suitable for PEA treatment, the multimodal treatment regimen combining BPA with targeted drugs is a safe and effective treatment option. However, the treatment plan should be individualized and implemented with long-term follow-up. Due to the short follow-up period in this case, long-term follow-up is needed to observe the efficacy of the treatment.

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References

[1] Yang J, Madani M M, Mahmud E, et al., 2023, Evaluation and Management of Chronic Thromboembolic Pulmonary Hypertension. Chest, 164(2): 490–502.

[2] Lang I M, 2008, Chronic Thromboembolic Pulmonary Hypertension. Dtsch Med Wochenschr, 133 Suppl 6: S206–S208.

[3] Yang J Z, Poch D S, Ang L, et al., 2023, Balloon Pulmonary Angioplasty in the Current Era of CTEPH Treatment: How Did We Get Here? Pulmonary Circulation, 13(4): e12312.

[4] Wilkens H, Konstantinides S, Lang I M, et al., 2018, Chronic Thromboembolic Pulmonary Hypertension (CTEPH): Updated Recommendations from the Cologne Consensus Conference 2018. International Journal of Cardiology, 272S: 69–78.

[5] Sharma M, Levine D J, 2021, Revisiting a Distinct Entity in Pulmonary Vascular Disease: Chronic Thromboembolic Pulmonary Hypertension (CTEPH). Medicina (Kaunas), 57(4): 355.

[6] van Kan C, Tramper J, Bresser P, et al., 2024, Patients with CTEPH and Mild Hemodynamic Severity of Disease Improve to a Similar Level of Exercise Capacity After Pulmonary Endarterectomy Compared to Patients with Severe Hemodynamic Disease. Pulmonary Circulation, 14(1): e12316.

[7] Delcroix M, Pepke-Zaba J, D'Armini A M, et al., 2024, Worldwide CTEPH Registry: Long-Term Outcomes with Pulmonary Endarterectomy, Balloon Pulmonary Angioplasty, and Medical Therapy. Circulation, 150(17): 1354–1365.

[8] Jaïs X, Brenot P, Bouvaist H, et al., 2022, Balloon Pulmonary Angioplasty Versus Riociguat for the Treatment of Inoperable Chronic Thromboembolic Pulmonary Hypertension (RACE): A Multicentre, Phase 3, Open-Label, Randomised Controlled Trial and Ancillary Follow-Up. Lancet Respiratory Medicine, 10(10): 961–971.

[9] Cottin V, Bensimon L, Raguideau F, et al., 2021, Hospital Costs of Balloon Pulmonary Angioplasty (BPA) Procedure and Management for CTEPH Patients: An Observational Study Based on the French National Hospital Discharge Database (PMSI). PLoS One, 16(12): e0260483.

[10] Shimokawahara H, Nishizaki M, Inami T, et al., 2025, Effect of Riociguat on Exercise Following Balloon Pulmonary Angioplasty in Patients with Inoperable Chronic Thromboembolic Pulmonary Hypertension in Japan (THERAPY-HYBRID-BPA): A Multicentre, Double-Blind, Randomised Study. Lancet Respiratory Medicine, 13(9): 789–799.

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A Brief Discussion on Nursing Care and Precautions During the Postoperative Recovery Period for Anorectal Patients

Qunqun Tao

The First Affiliated Hospital of Henan University of CM, Zhengzhou 450000, Henan, China

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Abstract: Anorectal diseases are common and frequently occurring clinical diseases, and surgical treatment is the main therapeutic method for many anorectal diseases. The quality of nursing care during the postoperative recovery period directly affects the final surgical effect, the incidence of complications, and patients' quality of life. Different from the conventional nursing mode of modern medicine focusing on anti-infection, analgesia, and wound management, traditional Chinese medicine (TCM) nursing emphasizes the holistic concept and treatment based on syndrome differentiation, featuring diverse methods, simplicity, low cost, remarkable efficacy, and emphasis on prevention and conditioning. Based on the clinical practice of TCM hospitals and without involving specific drugs, this paper systematically discusses the key nursing points for anorectal patients in the postoperative recovery period from the perspective of TCM, including TCM intervention methods in emotional conditioning, dietary recuperation, daily life nursing, specialized characteristic technologies, pain, and bleeding management. In addition, it elaborates on the life details that patients need to pay attention to during the recovery period. It aims to provide an effective postoperative nursing and rehabilitation guidance scheme with TCM characteristics for clinical practice, and help patients achieve physical and mental comprehensive development and rapid recovery.

Keywords: Anorectal postoperative period; Recovery nursing; Traditional Chinese medicine nursing

Online publication: Jun 30, 2026

1. Introduction

The anus is located in the lower part of the human body, known as the po gate in TCM, serving as the messenger of the five Zang-organs. Its physiology and pathology are closely related to the Qi and blood of the Zang-fu organs and the Yin-Yang balance of the whole body. The postoperative period of anorectal surgery is not only a process of local wound healing, but also a process of vital Qi recovery and gradual stabilization of Qi-blood harmony in the human body. Delayed conditioning and nursing will aggravate the occurrence of complications such as pain, bleeding, wound edema, and slow healing, and affect patients'

quality of life.

TCM nursing is an important part of traditional Chinese medicine, which highlights the holistic view and nursing based on syndrome differentiation. Anorectal postoperative nursing is not limited to wound care alone, but focuses on patients' mental emotions, diet and daily life, defecation and urination, tongue and pulse conditions. Comprehensive nursing measures are adopted to dredge meridians, regulate Qi and blood, clear away toxins and promote granulation, strengthen healthy Qi and eliminate pathogenic factors, so as to create the best internal environment for wound healing. Complementary to modern medical nursing, TCM characteristic nursing plays an irreplaceable role in relieving postoperative symptoms, reducing complications, accelerating rehabilitation, and improving patients' comfort.

2. Core nursing measures for anorectal patients during postoperative recovery

2.1. Emotional nursing

Surgical trauma and postoperative discomfort may cause patients to suffer from anxiety, fear, irritability, and other negative emotions. TCM holds that rage impairs the liver, overthinking impairs the spleen, and fear impairs the kidney. Improper emotions will lead to liver Qi stagnation and disorder of Qi movement, thereby affecting the operation of Qi and blood, spleen and stomach function, wound healing, and the recovery of defecation function [1].

First, communication and psychological counseling. Nursing staff should take the initiative to establish a good communication relationship with patients, adopt a kind and friendly attitude, and use concise language to carefully explain the disease development, the principles of treatment schemes, and the possible prognosis, so as to eliminate patients' various worries and anxiety. It is also necessary to actively guide patients to take the initiative to express their inner thoughts, provide channels for emotional venting, help them gradually get rid of negative emotions, and establish the confidence to overcome diseases [2].

Second, guide patients to participate in various beneficial physical and mental activities, such as appreciating soft and melodious music, reading positive and interesting books, watching relaxed and pleasant movies and TV dramas, diverting their excessive attention from physical pain and diseases, so as to improve their emotional state [3]. Further, according to the traditional TCM five-tone therapy, different modes of music are selected according to patients' specific physical constitution and emotional state, such as Jue mode corresponding to the liver for soothing liver and regulating Qi, and Gong mode corresponding to the spleen and stomach for invigorating spleen and calming mind, so as to soothe the liver and regulate Qi, invigorate the spleen and harmonize the stomach, and regulate emotions.

Third, calming the mind and tranquilizing the spirit. Instruct and guide patients to practice simple and feasible sitting meditation, mindfulness meditation, or progressive muscle relaxation exercises. Specifically, patients can adjust to a comfortable posture, focus their consciousness on the dantian, and consciously regulate breathing to make it deep, even, and slow. The integration of body and mind helps patients gradually achieve inner peace and mental concentration, thereby calming the mind, relieving anxiety and physical tension, and realizing physical and mental relaxation and balance [4].

2.2. Dietary conditioning

Postoperative dietary recuperation should follow the principles of gradual progress, adapting to local conditions and timely conditioning, with the general requirements of a light, digestible, and nutritious diet.

Spicy, dry-heat, greasy, and food that may induce diseases are prohibited.

First, the early postoperative period (1 to 3 days) is the stage of activating blood circulation, regulating Qi, clearing intestines, and relieving distension [5]. A liquid or semi-liquid diet is recommended, including millet porridge, Chinese yam porridge, lotus root starch, and vegetable soup. A small amount of radish soup can regulate Qi and harmonize the middle energizer, promote digestion and remove stagnation, and relieve abdominal distension.

Second, the middle recovery period (about 4 days after operation, wound healing) adopts the method of invigorating the spleen and strengthening healthy Qi to nourish the acquired foundation, nourish Yin, and consolidate the kidney to prevent congenital deficiency, replenish Qi and nourish Yin, moisten intestines, and relax bowels to assist rehabilitation treatment. The conditioning principle is to reinforce healthy Qi and replenish deficiency, consolidate primordial essence and benefit intelligence, nourish blood and strengthen the heart, and prevent damage and sequelae caused by chronic diarrhea and dysentery. The diet can be gradually converted to soft food and a regular diet [6]. Eat more cellulose-rich vegetables such as spinach, celery, and A*uricularia auricula*, and fruits such as banana, pitaya, and kiwifruit to ensure unobstructed defecation [7]. Moderate intake of high-quality protein, such as fish, lean meat, and eggs, promotes tissue repair and wound healing. Recommended dietary therapy recipes include *astragalus* and wolfberry stewed chicken, black sesame and walnut paste for moistening intestines and relaxing bowels.

2.3. Application of specialized characteristic technologies

Chinese herbal fumigation and sitz bath are two of the most commonly used and effective external TCM therapies after anorectal surgery. It directly acts on the perianal area through the thermal power and medicinal efficacy of decocted Chinese herbal medicine, with the effects of activating blood circulation and resolving stasis, detumescence, and analgesia, clearing away heat and detoxifying, removing necrotic tissue, and promoting granulation. The liquid temperature should be controlled at about 40 ℃, subject to the tolerance of the skin [8]. Each sitz bath lasts for 15 to 20 minutes. It is contraindicated for wounds with active bleeding. Commonly used Chinese herbal medicines have the effects of activating blood and detumescence, clearing heat and draining dampness, astringing wounds, and promoting granulation, which are prescribed by physicians based on syndrome differentiation [9].

Under the guidance of professionals, patients or their family members can be taught to press main acupoints such as Hegu, Zusanli, Sanyinjiao, Chengshan, and Changqiang by themselves or with assistance. Continuous acupoint pressing stimulation can dredge meridians and Qi-blood in the body, effectively relieve postoperative and chronic pain, regulate spleen and stomach function, promote digestion and absorption, dredge defecation and urination, and improve excretion status. Zusanli, an important health-care acupoint, can invigorate the spleen and replenish Qi, harmonize Qi and blood when pressed regularly, and significantly improve the body's self-repairing ability and recovery speed [10].

Select ear acupoints related to the anus, rectum, Shenmen, Sympathetic, Subcortex, Spleen, and Large Intestine. Paste vaccaria seeds on the corresponding acupoints for continuous pressing stimulation [11]. Press regularly 3 to 5 times a day. This mild and lasting external therapy can calm the mind and soothe nerves, relieve pain, regulate the balance of autonomic nerve function, improve intestinal peristalsis, local blood circulation, and visceral function.

Moxibustion warm therapy is applicable to patients with postoperative Qi and blood deficiency, slow

wound healing, local cold intolerance, and a preference for warmth or a cold physical constitution. After TCM syndrome differentiation by physicians, mild moxibustion or ginger-separated moxibustion can be applied on acupoints with warming and tonifying effects, such as Zusanli, Guanyuan, Qihai, and Shenque. Through the penetration of moxa heat and the warming and dissipating effect of ginger, it can warm and dredge meridians, replenish Qi and activate blood, strengthen healthy Qi, promote the growth of new granulation tissue, and accelerate the rehabilitation process [12].

3. Precautions for anorectal patients during postoperative recovery

3.1. Daily life precautions

First, moderate activity. Avoid prolonged standing, sitting, and squatting in the early postoperative period. Slow walking beside the bed and gentle stretching exercises can be performed to promote blood circulation. Strenuous exercise and heavy physical labor are prohibited for one month to prevent incision bleeding and edema. Anal contraction exercises can be performed many times a day for 5 to 10 minutes each time to strengthen the function of the anal sphincter.

Second, ensure adequate rest and develop a regular work and rest schedule with sufficient sleep. Sound sleep enables blood to return to the liver and facilitates the generation and transformation of Qi and blood [13].

Third, keep local cleanliness. Take a sitz bath with warm water or Chinese herbal liquid after defecation and before going to bed every day, and change underwear frequently. A shower is recommended while a tub bath is forbidden. Keep the anal area completely dry after bathing.

3.2. Self-observation of condition and follow-up visit

Observation contents: Pay daily attention to the shape and color of stool, presence of blood or mucus in stool, changes of anal pain, swelling, itching, and secretion, and abnormal oozing blood and exudate on wound dressing.

Identify early warning symptoms: Severe pain, increased bleeding such as dripping or jet bleeding, aggravated anal distending pain accompanied by obvious discomfort, chills and fever, and difficult urination all require immediate hospital treatment [14].

Regular re-examination: Return to the hospital on time as advised by doctors for wound healing observation and necessary treatment, including examination of ligature shedding and observation of wound drainage. Do not delay re-examination due to subjective judgment of wound recovery.

3.3. Long-term conditioning and recurrence prevention

(1) Moderate diet

Adhere to the long-term dietary principle of more vegetables and less oil, more coarse grains and less refined grains, maintain a balanced and reasonable diet structure, and strictly limit the intake of high-fat, high-sugar, high-salt, and refined processed food. In particular, spicy and irritating food, strong alcohol, and high-temperature frying cooking methods should be avoided. Ensure sufficient daily water intake to promote metabolism and blood circulation.

(2) Regular defecation

Develop a fixed daily defecation time to form a stable biological clock. Avoid reading and playing on mobile phones in the toilet to prevent distracted attention, prolonged squatting, and excessive straining,

which may cause anal damage.

(3) Avoid overstrain

Refuse long-term excessive fatigue and staying up late in daily life, so as to prevent disease recurrence and health deterioration caused by physical weakness and Qi deficiency [15]. Adhere to the principle of combining work and rest, arrange work and rest reasonably, and maintain an optimistic mental state, which is crucial to physical health.

(4) Avoid exogenous pathogenic factors

Keep the anal area warm and avoid sitting and lying in cold and humid places for a long time. Attach importance to chronic diseases that may increase abdominal pressure, such as persistent cough and chronic diarrhea, and take effective management measures to prevent adverse impacts on the anal area.

4. Conclusion

In summary, the postoperative recovery period of anorectal diseases is a comprehensive rehabilitation process involving physiological, psychological, and social aspects. TCM nursing has a solid and profound theoretical basis and a variety of effective nursing methods, showing unique advantages in postoperative rehabilitation. It stabilizes mental state through emotional regulation, protects the stomach and invigorates the spleen through dietary conditioning, directly acts on the lesion through unique characteristic operations, and takes daily life prevention as the fundamental system. This people-oriented nursing mode combining prevention and treatment can effectively improve postoperative symptoms, reduce complications, accelerate rehabilitation speed, and enhance patients' medical experience and self-health care awareness.

Clinical practice should give full play to the advantages of TCM nursing, integrate TCM nursing with modern nursing technologies, and establish a more complete and efficient rehabilitation scheme for anorectal postoperative patients. Meanwhile, strengthen health education for patients and their families to help them master relevant nursing measures and precautions, realize doctor-patient cooperation, achieve satisfactory therapeutic effects, and reduce recurrence rate.

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References

[1] Ma W, Zhu Y, 2025, Ways to Promote the Development of Integrated Traditional Chinese and Western Medicine Mode in General Hospitals Through Inheritance of TCM Surgery Theory. Journal of Traditional Chinese Medicine Management, 33(18): 108–110.

[2] Xu Y, Tan X, 2025, Effect of Functional Dressing Combined with Wound Ostomy Specialized Nursing on Postoperative Wound Recovery of Anorectal Patients. thesis, Chongqing Health Promotion and Health Education Association.

[3] Duan C, Wang L, Sun H, et al., 2025, Observation on Application Effect of Predictive Nursing Combined with Phased Health Education After Anorectal Surgery. Chinese Journal of Coloproctology, 45(07): 68–71.

[4] Wang Y, Huang Y, Liu J, et al., 2025, Clinical Efficacy of Intermuscular Groove Arc Incision Drainage for High

Perianal Abscess and Its Influence on Anorectal Dynamics. Chinese Journal of Minimally Invasive Surgery, 29(03): 195–199.

[5] Lin C, 2025, Effect of Chinese Herbal Fumigation Combined with Red Light Irradiation on Postoperative Pain and Wound Recovery of Anorectal Patients. Chinese Medicine Guide, 23(15): 147–149.

[6] Lin M, Huang Z, Yan J, 2025, Effect of Hydromorphone Combined with Ropivacaine Subarachnoid Block (Saddle Anesthesia) on Analgesia Duration and Postoperative Recovery of Anorectal Surgery. Journal of Chronic Diseases, 26(03): 377–380.

[7] Wu S, 2025, Effect of Chinese Herbal Fumigation and Sitz Bath Nursing Combined with Emotional Nursing on Postoperative Pain of Anorectal Patients. Chinese Medicine Guide, 23(02): 149–152.

[8] Yang Y, 2025, Effect of Transanal Endoscopic Minimally Invasive Surgery on Postoperative Recovery and Recurrence of Low Rectal Stromal Tumor Patients. Chinese Journal of Coloproctology, 45(01): 19–22.

[9] Bai R, 2025, Nursing Care and Precautions for Anorectal Patients During Postoperative Recovery Period. Everyone's Health, 2025(01): 126–128.

[10] Huang M, Wang E, Xu M, et al., 2025, Effect of Functional Dressing Combined with Wound Ostomy Specialized Nursing on Postoperative Wound Recovery of Anorectal Patients. Electronic Journal of Clinical General Surgery, 13(01): 102–106.

[11] Ren H, Ren S, Han S, 2024, Effect of Shengji Cuyu Decoction Combined With Ku Huai Fumigation Lotion on Postoperative Recovery, Anorectal Dynamics and Inflammatory Factors of Mixed Hemorrhoids. Hainan Medical Journal, 35(19): 2752–2757.

[12] Lu J, Yu N, Zhang L, et al., 2024, Research on the Application of TCM Clinical Pathway Based on Evidence-Based Nursing in Patients with Anorectal Diseases. Chinese and Foreign Medical Research, 43(28): 170–173 + 186.

[13] Yang T, Jiang M, 2024, Rational Application of Traceability Method to Strengthen the Role of Traditional Chinese Medicine Management Projects in Modern Anorectal Surgery. Journal of Traditional Chinese Medicine Management, 32(18): 212–214.

[14] Li S, 2021, Effect of Mindfulness Intervention on Postoperative Negative Emotions, Self-Efficacy and Self-Care Ability of Elderly Anorectal Patients. Heilongjiang Journal of Traditional Chinese Medicine, 50(05): 282–283.

[15] Wu D, 2021, Effect Analysis of Targeted Nursing Measures in Improving Postoperative Anal Pain and Defecation of Anorectal Patients. Medical Theory and Practice, 34(14): 2517–2518.

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Effects of Different Extraction Processes on the Anti-Tumor Activity of *Phellinus linteus*

Cong Min[1], Shenghua Wu[2], Rongxiang Wang[2], Zhaoyan Wei[2]

[1]Shaanxi University of Technology, Hantai District, Hanzhong 723000, Shaanxi, China
[2]Linqing Qingyuan Zhengben Biomedical Techn ology Co., Ltd., Linqing 252600, Shandong, China

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Abstract: *Phellinus linteus* is a traditional medicinal fungus in China, mainly including four common species with a long medicinal history. Modern pharmacology has confirmed that *Phellinus linteus* exhibits significant anti-tumor activity, and its core active components include polysaccharides, polyphenols, and terpenoids. The extraction process of *Phellinus linteus* greatly affects the dissolution, structural integrity, and anti-tumor activity of its active components. Different processes may lead to significant differences in the activity of extracts due to variations in their principles and operations. In view of this, this paper analyzes the effects of different extraction processes on the anti-tumor activity of *Phellinus linteus*, and proposes some prospects for optimization directions and application prospects, so as to provide references for the extraction of active components from *Phellinus linteus*.

Keywords: *Phellinus linteus*; Extraction process; Anti-tumor activity; Influence

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1. Introduction

Malignant tumors are a major global public health issue. The incidence and mortality rates of liver cancer, lung cancer, and other tumors remain high. Traditional radiotherapy and chemotherapy have significant side effects, so there is an urgent need for natural and efficient anti-tumor drugs and adjuvant treatment methods. The anti-tumor activity of *Phellinus linteus* is closely related to the extraction efficiency and structural integrity of its active components. Different extraction processes (such as water extraction and alcohol precipitation, ultrasonic-assisted extraction, microwave-assisted extraction, and enzymatic hydrolysis) significantly affect the yield, purity, and biological activity of active components [1]. Current research on *Phellinus linteus* mainly focuses on the activity verification of single components, lacking a systematic comparison of the inhibitory effects of different processes on multiple tumors. As the core medicinal part, the process optimization and clinical transformation research of fruiting bodies still need to be deepened. Combined with the 2026 tumor intervention goals, this study takes malignant tumors such as liver cancer and lung cancer as research objects, conducts comparative research on different extraction processes of *Phellinus*

linteus fruiting bodies, analyzes the effects of process parameters on the content of active components and anti-tumor activity, screens the optimal extraction scheme and optimizes the purification process, clarifies the inhibitory effect of *Phellinus linteus* on specific tumors, provides experimental basis for the development of anti-tumor preparations of *Phellinus linteus* and their application in clinical adjuvant therapy, and also lays a foundation for high-level academic research and achievement transformation [2].

2. Mechanism of anti-tumor activity of *Phellinus linteus*

The anti-tumor mechanism of Phellinus linteus is relatively complex, mainly achieved through inhibiting tumor cell growth, inducing apoptosis, and regulating the body's immunity. Different active components have different mechanisms of action, and there is a significant synergistic effect between them. Phellinus linteus polysaccharides are the core anti-tumor components, which can directly induce tumor cell apoptosis, arrest the cell cycle, and enhance immune surveillance function by regulating the body's immunity. Polysaccharides from different varieties of Phellinus linteus can basically exert good anti-tumor and immune regulatory effects[3]. Phellinus linteus polyphenols scavenge free radicals in the body through antioxidant activity, reduce DNA damage, and effectively inhibit the proliferation and differentiation of tumor cells. At the same time, polyphenols can regulate tumor signaling pathways, thereby greatly reducing the invasive and metastatic ability of tumors, making them extremely important anti-tumor substances in *Phellinus linteus*. *Phellinus linteus* terpenoids (mainly triterpenoids) can also significantly inhibit tumor cell proliferation, induce tumor cell apoptosis, and inhibit angiogenesis. Some active components have strong inhibitory effects on tumor cells with low toxicity to normal cells [4].

3. Effects of different extraction processes on the anti-tumor activity of *Phellinus linteus*

3.1. Traditional extraction processes

3.1.1. Hot water extraction method

The hot water extraction method is a traditional method for extracting active components from *Phellinus linteus*. It mainly uses water as a solvent and then breaks cell walls by heating to better promote the dissolution of water-soluble polysaccharides. It has the advantages of simple operation, low cost, and no residual organic solvents, making it very suitable for large-scale industrial production. It is currently widely used for the preliminary extraction of *Phellinus linteus* polysaccharides. In the hot water extraction method, parameters such as extraction temperature, time, and solid-liquid ratio greatly affect the dissolution amount and activity of polysaccharides. Excessively high temperature is likely to cause polysaccharide degradation, while excessively low temperature leads to insufficient dissolution. Only under appropriate conditions can the structure and activity of polysaccharides be well retained [5]. The shortcomings of this process are low extraction efficiency: hot water is difficult to penetrate cell walls, failing some active components to dissolve; there are many dissolved impurities; high temperature can also cause pyrolysis, leading to low polysaccharide yield, which is difficult to meet the demand for high-activity extracts.

3.1.2. Ethanol extraction method

The ethanol extraction method is mainly used for extracting fat-soluble components *from Phellinus linteus*. Workers can use the polarity of ethanol to destroy the lipid bilayer of cells, thereby promoting the dissolution

of components such as polyphenols and terpenoids. At the same time, it can effectively inhibit the growth of microorganisms, with the advantages of simple operation and strong selectivity. In the ethanol extraction method, the concentration of ethanol is a crucial parameter. Excessively high concentration causes cell dehydration, which is not conducive to component dissolution; excessively low concentration easily leads to insufficient dissolution of fat-soluble components. Only under appropriate conditions can fat-soluble extracts with strong activity be obtained [6]. The advantages of the ethanol extraction method are high purity of extracts and easy recovery of ethanol. The disadvantages are that ethanol itself has certain toxicity, so the entire operation process needs strict control; this method has a poor extraction effect on some water-soluble components; prolonged high temperature can cause oxidative degradation of fat-soluble components, affecting extraction efficiency.

3.2. Novel assisted extraction processes

3.2.1. Ultrasonic-assisted extraction method

In the extraction of *Phellinus linteus*, the ultrasonic-assisted extraction method is a novel extraction technology that mainly uses the mechanical vibration and cavitation effect of ultrasonic waves to destroy cell structures, thereby realizing the dissolution of active components. As a new green process, it has the advantages of high extraction efficiency, short time, and good retention of active components, and has been widely used in the research on the extraction of active components from *Phellinus linteus*. In the ultrasonic-assisted extraction method, ultrasonic power and time are crucial parameters. Excessively low power makes it difficult to break cell walls, while excessively high-power causes component degradation. Only under appropriate conditions can efficiency be guaranteed [7]. The ultrasonic-assisted extraction method also has a significant extraction effect on fat-soluble components. The ultrasonic-assisted enzymatic method can achieve very good extraction efficiency, and the overall yield is much higher than other traditional auxiliary methods. The shortcomings of the ultrasonic-assisted extraction method are that excessively high power or prolonged time can degrade active components; during large-scale extraction, uneven extraction may occur; the overall equipment investment cost is relatively high [8].

3.2.2. Microwave-assisted extraction method

The microwave-assisted extraction method is an extraction technology that uses the thermal and non-thermal effects of microwaves to destroy cell structures, promote the dissolution of active components, and has the advantages of high extraction efficiency and low energy consumption. It has become an important research hotspot in recent years. In microwave-assisted extraction, microwave power and time are also important parameters. Excessively low microwave power is likely to cause uneven heating and insufficient dissolution; excessively high microwave power leads to local high temperatures that damage components. Only under appropriate conditions can the extraction time be greatly shortened, the dissolution amount of polysaccharides be increased, and the active components extracted by this method are better than those by traditional methods [9]. The advantages of the microwave-assisted extraction method are high efficiency, energy saving, and good retention of active components, making it very suitable for industrial production. The disadvantages are that uneven microwave heating may cause damage to some components; special equipment is required, which invisibly increases investment; the extraction effect on some high-viscosity systems is not ideal.

3.2.3. Enzymatic hydrolysis-assisted extraction method

The enzymatic hydrolysis-assisted extraction method mainly uses biological enzymes such as cellulase and

pectinase to decompose cell wall components, thereby destroying cell structures and enabling the dissolution of active components. This method can greatly improve extraction efficiency, has excellent retention of active components, and causes little environmental damage. In the enzymatic hydrolysis-assisted extraction method, the type of enzyme and the enzymatic hydrolysis conditions are crucial. Cellulase and pectinase can effectively destroy cell walls, while protease can reduce the dissolution of impurities. Under appropriate conditions, the dissolution amount of polysaccharides is higher than that of the traditional hot water extraction method, and the overall structure and activity are better. The advantages of the enzymatic hydrolysis-assisted extraction method are high purity of extracts and environmental friendliness. The disadvantages are high enzyme cost, strict control of enzymatic hydrolysis conditions, high overall operation difficulty, and long enzymatic hydrolysis time, which makes it difficult to be widely applied in industrial production at present [10].

3.3. Other novel extraction processes

3.3.1. Fermentation extraction method

The fermentation extraction method is an extraction technology that uses microbial metabolic effects to convert macromolecular active components of *Phellinus linteus* into small molecules. At the same time, it can effectively destroy cell structures and better promote the dissolution of active substances. The fermentation extraction method has the advantages of high extraction efficiency, strong activity of active components, and low overall cost. In the fermentation extraction method, fermentation strains are the most important factor, and different strains have significant differences in transformation effects. Under appropriate conditions, the yield of fermented polysaccharides is significantly higher than that of the traditional hot water extraction method. At the same time, the polysaccharides obtained by the fermentation extraction method have stronger antioxidant and anti-tumor activities. The advantages of this process are that it can greatly improve the bioavailability of active components and produce some new active components, making it very suitable for industrial production [11]. The disadvantages of the fermentation extraction method are a complex fermentation process, high overall operation difficulty, certain difficulty in strain screening and optimization, and complex composition of fermentation products, which greatly increases the difficulty of separation and purification.

3.3.2. Supercritical carbon dioxide extraction method

The supercritical carbon dioxide extraction method is an extraction technology that uses the solubility and permeability of supercritical carbon dioxide to extract fat-soluble components from *Phellinus linteus* effectively. It has the advantages of high extraction efficiency, good retention of active components, and no residual organic solvents. As a high-end extraction process, it is mainly used for the extraction of high-purity active components. In the actual extraction process, extraction pressure and temperature are the most crucial parameters, which greatly affect the solubility of carbon dioxide and the dissolution of components. Under appropriate conditions, the supercritical carbon dioxide extraction method can greatly increase the dissolution amount of terpenoid components, with higher overall purity, and its anti-tumor activity is significantly better than that of the traditional ethanol extraction method. It is also an important research content for the extraction of triterpenoid components from *Phellinus linteus* [12].

4. Optimization directions and prospects of extraction processes

4.1. Optimization directions of extraction processes

At present, there are still some problems to be improved in the extraction process of *Phellinus linteus* in China, such as insufficient structural integrity of active components, high production cost, and great difficulty in subsequent separation and purification. For this reason, we can carry out the following process optimizations:

First, optimize the composite extraction process. We can combine two or more extraction processes to give play to their respective advantages, further improve extraction efficiency, and the retention rate of active components. For example, we can try to use the ultrasonic-enzymatic hydrolysis composite extraction method for extraction, which can greatly improve extraction efficiency and the anti-tumor activity of extracts.

Second, optimize extraction parameters. Researchers can use methods such as single-factor experiments, orthogonal experiments, and response surface methodology to optimize the key parameters of the extraction process, so as to find the optimal extraction conditions, thereby greatly improving extraction efficiency and the dissolution amount of active components, and helping to reduce the degradation of active components.

Third, optimize the research, development, and application of novel solvents. We can find some efficient and environmentally friendly extraction solvents to replace traditional water and ethanol, which can greatly improve extraction efficiency and the retention rate of active components. For example, we can introduce deep eutectic solvents (DES), a new type of green solvent, which can greatly improve the extraction efficiency of *Phellinus linteus* polyphenols. At the same time, this solvent is environmentally friendly and non-toxic, and can greatly reduce production costs [13].

4.2. Prospects

As a very precious medicinal fungus, the anti-tumor activity of *Phellinus linteus* has very broad research value and application prospects. With the continuous development of extraction technology, the extraction process of *Phellinus linteus* is gradually moving towards a more efficient, green, and environmentally friendly direction. In the future, we should further strengthen the research and development of composite extraction processes and better combine technologies such as ultrasound, microwave, and enzymatic hydrolysis to achieve a higher level of extraction of active components from *Phellinus linteus*. In addition, relevant personnel can further strengthen the research on the anti-tumor activity mechanism of *Phellinus linteus*, so as to clarify the effects of different extraction processes on the structure and mechanism of active components, thereby providing a more sufficient theoretical basis for the subsequent optimization of extraction processes [14].

Furthermore, we need to strengthen the industrial transformation of the *Phellinus linteus* extraction process, further optimize the production process, and reduce production costs, so as to better realize the large-scale production of *Phellinus linteus* anti-tumor products. In terms of quality control of *Phellinus linteus* products, we can try to establish a more scientific quality evaluation system to better ensure the safety and effectiveness of products. At present, the relevant departments have issued local standards for food safety related to *Phellinus linteus*, which clearly stipulate the minimum content requirements of main active components, providing an important basis for the quality control of *Phellinus linteus* products. By continuously improving the relevant industry standards, we can provide more key guarantees for the standardized production of *Phellinus linteus* raw materials [15]. With the continuous improvement of people's demand for natural anti-tumor drugs, the optimization of the extraction process and product research and development of *Phellinus linteus* will become a research hotspot in the future. Through the continuous efforts of researchers, the relevant extraction processes of *Phellinus linteus* will be continuously improved, and their anti-tumor activity will be more fully exerted, which invisibly provides a new idea and method for the treatment of tumors.

Disclosure statement

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References

[1] Sun K, Liu X, Jin X, et al., 2024, Research Progress on Anti-Tumor Active Components and Their Mechanisms of Action of Phellinus igniarius. Progress in Biotechnology, 14(06): 929–936.

[2] Yang Y, Lei X, Xie L, et al., 2024, Optimization of Co-Fermentation Process of *Inonotus hispidus* and *Phellinus vaninii* and Analysis of Anti-Tumor Activity of Exopolysaccharides. Edible Fungi of China, 43(03): 78–85 + 106.

[3] Ge J, 2024, Isolation, Purification, and Heterologous Expression of Anti-Tumor Active Proteins from *Phellinus linteus* Mycelium, thesis, Huazhong Agricultural University.

[4] Su C, Yang Z, Ye L, et al., 2023, Microbial Exogenous Induction of Polysaccharide Synthesis in Poria cocos Mycelium. Proceedings of the 12th Academic Seminar on Medicinal Fungi: 102.

[5] Liu J, Wei B, Bi W, et al., 2023, Chemical Constituents and Anti-Tumor Activity of the Mycelium of *Phellinus linteus*-Kelp Two-Way Fermentation. Food Research and Development, 44(19): 61–67.

[6] Wei B, Liu J, Bi W, et al., 2023, Optimization of Liquid Fermentation Process and In Vitro Anti-Tumor Activity of Medicinal Fungus *Phellinus linteus*. Biochemical Engineering, 9(04): 19–25.

[7] Li Y, Li F, Yang X, et al., 2023, Isolation, Purification, Antioxidant and Anti-Tumor Activity Analysis of Polysaccharides from *Phellinus linteus* Mycelium. Science and Technology of Food Industry, 44(11): 127–135.

[8] Zhang J, 2022, Comparative Study on Immunomodulatory and In Vitro Anti-Tumor Activities of *Phellinus linteus* From Different Varieties and Cultivation Methods, thesis, Anhui Medical University.

[9] Hou Y, Ma J, Li N, 2022, Effects of Different Origins, Cultivation Modes and Substrates on the Content of Main Components and In Vitro Anti-Tumor Activity of *Phellinus linteus*. Journal of Chinese Medicinal Materials, 45(03): 536–541.

[10] Yang Y, 2021, Study on Anti-Tumor Effects and Mechanisms of Total Extracts from Phellinus linteus and Its Active Monomer Osmundacetone, thesis, Anhui Medical University.

[11] He P, Yang Y, Di L, et al., 2020, Comparative Study on In Vitro Anti-Tumor Activity of Medicinal *Phellinus baumii* Cultivated on Different Substrates. Mycosystema, 39(07): 1400–1409.

[12] Huang L, An C, Liu D, et al., 2019, Effects of Total Flavonoids from Liquid-Fermented Phellinus linteus on Anti-Tumor Activity and Cell Cycle. Journal of Shandong University of Technology (Natural Science Edition), 33(02): 65–68 + 73.

[13] Wu X, Wang C, Bao H, 2018, Study on Anti-Tumor Activity of Aqueous Extracts from Different "*Phellinus linteus*"-Like Fungi. Biotechnology Bulletin, 34(08): 138–143.

[14] Lü H, 2018, Comparative Study on Anti-Tumor Activities of Polysaccharides and Flavonoids from *Phellinus linteus*. China Journal of Chinese Materia Medica, 33(01): 27–29.

[15] Ying R, Wu C, Huang M, et al., 2017, Study on Anti-Tumor Activity of Polysaccharides from Fruiting Bodies and Mycelia of *Phellinus linteus*. China Food Additives, 2017(12): 57–61.

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Research Progress on the Treatment of Polycystic Ovary Syndrome with Traditional Chinese Medicine

Yingfang Fan[1], Xin Yang[1], Ziyi Yang[1], Xiaohui Qu[2]*

[1]Shaanxi University of Chinese Medicine, Xianyang 712000, Shaanxi, China
[2]The Second Affiliated Hospital of Shaanxi University of Chinese Medicine, Xianyang 712000, Shaanxi, China

Author to whom correspondence should be addressed.

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Abstract: Polycystic ovary syndrome (PCOS) is a common gynecological endocrine disorder that seriously affects women's reproductive health and quality of life. PCOS, a common and frequently occurring reproductive endocrine disorder among women of puberty and childbearing age, with its complex pathological mechanisms and diverse clinical manifestations, has become a hot and difficult topic in gynecological medical research both at home and abroad. Although there is no modern name "polycystic ovary syndrome" in traditional Chinese medicine, based on its clinical manifestations, it can be classified into the categories of "menstrual disorders", "infertility", "masses", etc., for syndrome differentiation and treatment. In recent years, traditional Chinese medicine has played an important role in the clinical treatment of PCOS. This article reviews the understanding of the etiology and pathogenesis, diagnostic methods, therapeutic approaches, and clinical research progress of PCOS through traditional Chinese medicine, aiming to provide a reference for the clinical treatment of PCOS.

Keywords: Polycystic ovary syndrome; Etiology and pathogenesis; Diagnosis; Treatment; Research progress

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1. Introduction

Polycystic ovary syndrome is a common gynecological endocrine disorder characterized by clinical or biochemical manifestations of hyperandrogenism, persistent anovulation, and polycystic changes in the ovaries [1]. PCOS not only causes menstrual disorders, infertility, hirsutism, obesity, and other symptoms, but also increases the risk of long-term complications such as diabetes and cardiovascular disease. At present, Western medicine mainly treats PCOS by regulating endocrine, inducing ovulation, improving insulin resistance, or addressing specific symptoms and targeting certain pathophysiological links, which have obvious effects but have certain side effects and limitations. Traditional Chinese medicine has

unique advantages in the treatment of PCOS. Through syndrome differentiation and treatment, and the comprehensive application of various therapeutic methods such as Chinese herbal medicine, acupuncture, and massage, it can effectively improve the symptoms of patients and enhance clinical efficacy.

2. Understanding of the etiology and pathogenesis of PCOS in traditional Chinese medicine

2.1. Etiology

2.1.1. Insufficiency of innate endowment

Congenital insufficiency is one of the important causes of gynecological diseases. In Miraculous Pivot: Five Tones and Five Tastes, it is written: "The birth of a woman has more than Qi and less than blood, and thus loses blood". This indicates that women are born with a weaker constitution and are prone to insufficiency of Qi and blood. The kidneys are the foundation of the innate constitution and govern reproduction [2]. Insufficiency of innate endowment, weakness of kidney Qi, deficiency of heavenly essence, and imbalance of Chong and Ren meridians can lead to menstrual disorders, infertility, and other conditions similar to the clinical manifestations of polycystic ovary syndrome.

2.1.2. Dysregulation of emotions

Emotional imbalance is also one of the important factors causing gynecological diseases. "All diseases arise from Qi. Anger causes Qi to rise, joy causes Qi to slow down, sorrow causes Qi to dissipate, fear causes Qi to descend, cold causes Qi to gather, heat causes Qi to release, shock causes Qi to disorder, toil causes Qi to deplete, thought causes Qi to block" [3]. This indicates that emotional imbalance affects the movement of Qi in the body, leading to disharmony of Qi and blood and imbalance of the chong and Ren meridians. The liver governs the smooth flow of Qi. Long-term mental stress, anxiety, depression, and other emotional disorders can lead to liver Qi stagnation, abnormal flow of Qi, disharmony of Qi and blood, and imbalance of chong and Ren meridians, thereby causing symptoms similar to polycystic ovary syndrome.

2.1.3. Improper diet

Unhealthy dietary habits constitute another major pathogenic factor triggering female genital ailments. As documented in Plain Questions · Treatise on Bi Syndrome, overindulgence in food intake will injure gastrointestinal functions. Unregulated eating habits impair the spleen-stomach system and weaken the body's digestion and nutrient absorption capacity. Heavy intake of greasy, sweet, spicy, or irritant food hurts spleen and stomach functions, disturbs spleen transportation, and causes lingering phlegm-damp retention inside the body. Such pathological damp-phlegm blocks the thoroughfare and conception vessels, eventually resulting in irregular menstruation, amenorrhea, barrenness, and multiple symptoms matching polycystic ovary syndrome.

2.1.4. Improper work-rest arrangement

Either physical overstrain or prolonged sedentary inactivity easily induces gynecologic disorders. The classical record from Plain Questions · Five Energies Thesis states: long-time eye strain damages blood; excessive bed rest consumes primordial Qi; prolonged sitting harms muscle tissue; prolonged standing impairs osseous tissue; excessive walking injures tendons.

This ancient viewpoint proves that irregular rest and labor break normal blood-Qi circulation inside the human body, contributing to disharmonized Qi-blood and dysfunction of Chong-Ren vessels. Both overexertion and excessive idling impair spleen and kidney essence, trigger deficient Qi and blood as well as deranged Chong-Ren meridians, which further induce pathological manifestations.

2.2. Pathogenesis

2.2.1. Kidney deficiency is the root cause

The kidneys store essence and govern reproduction. Kidney deficiency is the fundamental pathogenesis of PCOS. Deficiency of kidney Qi, insufficiency of heavenly essence, and deficiency of Chong and Ren meridians can lead to irregular menstruation and infertility. Weakness of kidney Yang, unable to warm the spleen Yang, can lead to deficiency of spleen and kidney Yang, retention of water and dampness, and aggravation of phlegm-dampness obstruction. Deficiency of kidney Yin, unable to nourish liver wood, can lead to liver and kidney Yin deficiency and internal generation of false fire [4].

2.2.2. Liver depression and Qi stagnation

The liver governs the smooth flow of Qi throughout the body. When the liver Qi is depressed and the free flow is abnormal, it can lead to poor circulation of Qi and blood and an imbalance of the chong and Ren meridians. When liver depression affects the spleen, it can lead to spleen deficiency and internal generation of phlegm and dampness. When liver depression turns into fire, it can cause internal disturbance of heat and force blood to flow wrongly.

2.2.3. Phlegm-dampness obstruction

The spleen governs the transformation and transportation of water and dampness. If the spleen fails to function properly, water and dampness will accumulate and generate phlegm. Phlegm-dampness blocking the Chong and Ren meridians can lead to irregular menstruation, amenorrhea, and infertility. Internal accumulation of phlegm and dampness can also affect the circulation of Qi and blood and aggravate the condition.

2.2.4. Internal obstruction of blood stasis

Prolonged illness can invade the meridians and cause poor circulation of Qi and blood, leading to internal obstruction of blood stasis. Blood stasis blocking the Chong and Ren meridians can lead to irregular menstruation, dysmenorrhea, amenorrhea, etc. Blood stasis and phlegm-dampness bind together, making the condition more complicated to treat.

3. Diagnostic methods for PCOS in traditional Chinese medicine

3.1. Four diagnostic methods combined

The diagnosis of polycystic ovary syndrome in traditional Chinese medicine primarily relies on the combined approach of observation, auscultation and olfaction, inquiry, and palpation. Observation, by observing the patient's complexion, shape, tongue coating, etc., to determine the abundance or deficiency of Qi and blood and the function of the internal organs; Auscultation involves listening to the patient's voice and smell to understand the changes in the condition; Inquiry, asking about the patient's medical history, symptoms, living

habits, etc., to obtain comprehensive information; Palpation involves pressing the patient's pulse with a finger to feel the rise, fall, delay and count of the pulse to determine whether the illness is cold, heat, deficiency or excess [5]. In the diagnosis of diseases, traditional Chinese medicine pays particular attention to observing the patient's menstrual conditions, such as the cycle, changes in volume, color, and texture, and whether there are symptoms such as dysmenorrhea and amenorrhea. At the same time, it also pays attention to changes in the patient's body shape, such as obesity, excessive hair, and external manifestations like acne on the face, which are important bases for TCM to judge whether the circulation of Qi and blood and the functions of the internal organs are out of balance.

3.2. Syndrome differentiation and typing

3.2.1. Liver Qi stagnation type

(1) Clinical manifestations

PCOS sufferers belonging to the liver Qi stagnation pattern frequently suffer from depressive mood, nervousness, and vexation, accompanied by distending pain over the chest and hypochondrium, as well as mammary distending discomfort. Their menstrual cycle tends to be chaotic, featuring hypomenorrhea or even secondary amenorrhea; facial acne also emerges recurrently. Tongue manifestation includes a pale-red tongue body with thin white fur, alongside a string-like or string-thready pulse.

(2) Therapeutic approaches

Dredge stagnated liver Qi to ease emotional constraint and modulate visceral Qi activity. From the TCM theoretical perspective, the liver is in charge of smooth Qi dispersion. Once liver Qi falls into stagnation, visceral Qi movement becomes obstructed, which hampers blood circulation and compromises the physiological functions of Chong and Ren vessels. Hence, clinical management centers on liver-soothing and depression-relief, paired with Qi-blood regulation to bring menstrual rhythm back to normal.

(3) Common herbal selections

Prescriptions for this syndrome regularly deploy bupleurum root, white peony root, cyperus rotundus rhizome, and similar medicinal herbs for resolving liver stagnation. Clinicians usually add blood-circulating and stasis-eliminating botanicals, including Chinese angelica and Sichuan lovage rhizome, to optimize systemic blood perfusion.

3.2.2. Spleen deficiency with dampness obstruction type

(1) Clinical manifestations

Patients diagnosed with PCOS of spleen deficiency and dampness stagnation pattern generally exhibit typical constitutional symptoms, including an overweight tendency, persistent lassitude, poor digestive capacity despite normal appetite, and unformed stool. Menstrual disturbance is commonly observed, characterized by delayed menstrual cycle, reduced menstrual volume, pale menstrual blood color, and thin blood texture. Typical tongue and pulse conditions consist of a pale and enlarged tongue with dental indentations, white and slippery tongue coating, as well as a slippery and thready pulse.

(2) Therapeutic principle

Tonify the spleen to eliminate internal dampness, and harmonize Qi and blood conditions within the body. In traditional Chinese medicine theory, the spleen undertakes the core function of transporting and transforming water-damp substances throughout the body. Insufficient spleen Qi inevitably leads to

dysfunction of water-damp metabolism, further causing endogenous phlegm-damp accumulation and visceral obstruction. Accordingly, clinical treatment prioritizes invigorating spleen function and dispelling dampness turbidity. Auxiliary regulation of Qi and blood circulation is essential to restore a regular menstrual rhythm [5].

(3) Common medicinal applications

Herbal medicines capable of replenishing spleen Qi, drying dampness, and dissolving phlegm are predominantly adopted for this syndrome, such as *Astragalus membranaceus*, *Codonopsis pilosula*, and *Poria cocos*. To further ameliorate systemic microcirculation and unblock stagnated circulation, blood-nourishing and circulation-promoting herbs, including Angelica sinensis and *Ligusticum chuanxiong*, are often supplemented in compound prescriptions.

3.2.3. Kidney Yang deficiency type

(1) Symptoms

Patients with kidney Yang deficiency type often show symptoms such as pale complexion, soreness and weakness of the waist and knees, aversion to cold and cold limbs, and irregular menstruation. Menstruation is often scanty and pale in color in the later stage, and amenorrhea may occur. A pale tongue with a white coating and a fine, weak pulse can be seen on the tongue.

(2) Treatment principles

Warming Yang and tonifying the kidney, regulating the meridians. According to traditional Chinese medicine, the kidney is the foundation of the innate constitution. Deficiency of kidney Yang leads to dysfunction of the Chong and Ren meridians, which affects the normal onset of menstruation. Treatment should focus on warming Yang and tonifying the kidney, while also regulating the meridians to ensure the normal flow of Qi and blood.

(3) Common medications

Medicines such as *Rehmannia glutinosa*, *Cinnamomum cassia*, and *Curculigo orchioides*, which have the effects of tonifying the kidney and strengthening Yang and warming and tonifying the meridians, are often used in the treatment of such patients [6]. At the same time, it can be combined with blood-activating drugs such as *Angelica sinensis* and *Ligusticum chuanxiong* to improve blood circulation.

3.2.4. Kidney Yin deficiency type

(1) Symptoms

Patients with kidney Yin deficiency type often present with delayed menarche, scanty and pale menstrual flow in the later stage, and eventually amenorrhea. It may also be accompanied by symptoms such as a small body shape and acne on the forehead. The tongue shows a red tongue with little coating and a fine, rapid pulse.

(2) Treatment principles

Nourish the kidney and replenish essence, regulate menstruation, and assist conception. According to traditional Chinese medicine, a deficiency of kidney Yin leads to insufficiency of heavenly essence and malnutrition of the Chong and Ren meridians, resulting in irregular menstruation. Treatment should focus on nourishing the kidneys and replenishing essence, while also regulating the functions of the Chong and Ren meridians to promote normal menstruation and conception.

(3) Common drugs

Rehmannia glutinosa, *Cornus officinalis*, yams, and other drugs with the function of nourishing kidney

Yin in the modified formula of Zuogui Pills are often used for the treatment of such patients. At the same time, it can be combined with blood-activating drugs such as *Angelica sinensis* and *Ligusticum chuanxiong* to improve blood circulation.

4. Traditional Chinese medicine treatment methods for PCOS

4.1. A single Chinese herb

4.1.1. Epimedium

Epimedium has the effects of tonifying the kidney and strengthening Yang, dispelling wind and dampness. Modern research shows that epimedium can increase the ovaries' sensitivity to gonadotropins and promote follicular development and ovulation; It can also lower androgen levels and raise estrogen levels [7].

4.1.2. Danshen

Salvia miltiorrhiza has the effects of promoting blood circulation and removing blood stasis, regulating menstruation, and relieving pain. Modern research shows that *Salvia miltiorrhiza* can improve microcirculation and increase tissue sensitivity to insulin; It can also lower androgen levels and raise estrogen levels [8].

4.1.3. *Poria cocos*

Poria cocos has the effects of strengthening the spleen, promoting diuresis, calming the mind, and soothing the spirit. Modern research shows that poria can improve insulin resistance and lower blood sugar and insulin levels; It can also regulate the immune function and enhance the body's immunity.

4.2. Acupuncture treatment

4.2.1. Body acupuncture therapy

(1) Selection principles

According to the etiology, pathogenesis, and clinical manifestations of PCOS, select acupoints that have the functions of tonifying the kidney and strengthening the spleen, soothing the liver and regulating Qi, promoting blood circulation and removing blood stasis, eliminating phlegm and promoting diuresis. Common acupoints include Guanyuan, Qihai, Zhongji, Gongzi, Guailai, Sanyinjiao, Xuehai, Zusanli, Taichong, etc [9].

(2) Procedure

The patient is placed in a supine or prone position. After routine disinfection of the skin of the acupoint, a filiform needle is used to prick the acupoint. The needle is retained for 20 to 30 minutes after Qi is obtained. During this period, the needle can be inserted appropriately to enhance the sensation of the needle. Treatment 2–3 times a week, with 10 sessions as one course.

4.2.2. Auricular acupuncture therapy

(1) Selection principles

Select auricular points related to the reproductive system, endocrine system, nervous system, etc. Common acupoints include the endocrine, ovary, Shenmen, liver, spleen, kidney, etc.

(2) Method

After disinfecting the skin of the auricle with an alcohol cotton ball, apply the seeds of Plantago

japonicus or magnetic beads to the auricular points, applying to one auricular point at a time, and changing every 3 to 5 days, alternating between the two ears. Instruct the patient to press the auricular points 3–5 times a day by themselves, for 1–2 minutes each time.

4.2.3. Moxibustion therapy

(1) Selection principles

Select acupoints that have the functions of warming Yang and tonifying the kidney, strengthening the spleen and promoting diuresis, and activating blood and removing blood stasis. Common acupoints include Guanyuan, Qihai, Shenzhu, Zhongji, Gongzi, Guailai, Sanyinjiao, Zusanli, etc.

(2) Method

Use moxa stick suspension moxibustion or moxa cone moxibustion on the acupoints for 15–20 minutes each time, 2–3 times a week, 10 times as one course of treatment.

4.2.4. Combined therapy

Depending on the patient's specific condition, body acupuncture, auricular acupuncture, moxibustion and other therapies can be combined and used in combination to improve the therapeutic effect.

4.3. Massage therapy

4.3.1. Abdominal massage

The patient lies in a supine position. The physician massages the patient's abdomen clockwise with the palm for 10–15 minutes each time, 1–2 times a day. The doctor uses his fingers to press the Guanyuan, Qihai, Zhongji, uterus, and other acupoints on the patient's abdomen for 1 to 2 minutes each time, 1 to 2 times a day.

4.3.2. Massage of the waist

The patient is in a prone position. The physician massages the patient's waist clockwise with the palm for 10–15 minutes each time, 1–2 times a day. The doctor uses his fingers to press the acupoints on the patient's waist, such as Shenshu, Mingmen, and Yaoyangguan, for 1 to 2 minutes each time, 1 to 2 times a day.

4.3.3. Massage of the limbs

The patient is in a supine or sitting position. The physician uses fingers to press the Zusanli, Sanyinjiao, Xuehai, Hegu, and other acupoints on the patient's limbs for 1 to 2 minutes, 1 to 2 times a day. The doctor kneads the muscles of the patient's limbs with the palm for 10–15 minutes each time, 1–2 times a day.

5. Advances in clinical research on traditional Chinese medicine for PCOS

5.1. Clinical efficacy

A number of clinical studies have shown that traditional Chinese medicine has good clinical efficacy in treating PCOS. Chinese herbal medicine, acupuncture, massage, and other treatments can effectively improve symptoms such as menstrual disorders, infertility, hirsutism, obesity, increase ovulation and pregnancy rates, and reduce androgen levels and insulin resistance index. In recent years, with the deepening of research on traditional Chinese medicine and the accumulation of clinical practice, significant progress has been made

in clinical research on the treatment of PCOS with traditional Chinese medicine. For example, research by Professor Tang Qiqun's team from Fudan University shows that artemisinin derivatives can improve PCOS symptoms by mediating LONP1-CYP11A1 interactions. This discovery not only reveals the potential value of artemisinin in the treatment of PCOS but also provides new ideas and methods for the modernization of traditional Chinese medicine research.

In addition, significant progress has been made in the acupuncture treatment of PCOS in traditional Chinese medicine. The "Study on the Efficacy and Safety of Acupuncture for Oligomenorrhea in Polycystic Ovary Syndrome: An International multicenter Randomized Controlled Pre-Trial" project, jointly conducted by the China Academy of Chinese Medical Sciences and the Korea Institute of Korean Medicine, further verified the efficacy and safety of acupuncture in the treatment of PCOS [10]. These findings not only provide strong evidence for the treatment of PCOS with traditional Chinese medicine but also offer valuable references and lessons for the international medical community.

5.2. Mechanism of action

5.2.1. Regulating endocrine

It can promote follicular development and ovulation by regulating the function of the hypothalamic-pituitary-ovarian axis, reducing androgen levels, and increasing estrogen levels. For example, kidney-tonifying herbs can enhance the ovaries' sensitivity to gonadotropins and promote follicular development and ovulation; Chinese medicines that soothe the liver and regulate Qi can regulate the neuroendocrine system, improve mood, and relieve symptoms such as anxiety and depression.

5.2.2. Improve insulin resistance

The risk of long-term complications such as diabetes and cardiovascular diseases can be reduced by improving insulin resistance, lowering blood sugar, and insulin levels. For example, traditional Chinese medicine for strengthening the spleen and eliminating phlegm can improve insulin resistance and lower blood sugar and insulin levels; Chinese herbs can improve microcirculation and increase tissue sensitivity to insulin.

5.2.3. Regulating immune function

Regulating the immune function can suppress the inflammatory response, reduce local immune damage to the ovaries, and promote the recovery of ovarian function. For example, traditional Chinese medicine for tonifying the kidney can regulate immune function and enhance the body's immunity; Heat-clearing and detoxifying herbs can suppress inflammatory responses and reduce local immune damage to the ovaries.

6. Conclusion

To sum up, traditional Chinese medicine has unique advantages in the clinical treatment of PCOS. By understanding the etiology and pathogenesis of PCOS, using the method of syndrome differentiation and treatment, and integrating various therapeutic methods such as Chinese herbal medicine, acupuncture, and massage, traditional Chinese medicine can effectively improve the symptoms of patients and enhance the clinical efficacy. At the same time, the treatment of PCOS with traditional Chinese medicine is highly safe and does not cause damage to the liver and kidney functions of patients. Therefore, traditional Chinese

medicine has broad application prospects in the clinical treatment of PCOS. However, there are still some deficiencies in the current research on PCOS in traditional Chinese medicine, such as the lack of large-sample, multi-center clinical studies and the insufficient in-depth study of the mechanism of action. In the future, we should further strengthen clinical research on PCOS in traditional Chinese medicine, explore its mechanism of action in depth, and provide more scientific and effective methods for the clinical treatment of PCOS.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Xiang Y, Tan S, 2023, Summary of the Experience of Renowned Traditional Chinese Medicine Expert Xie Leye in Treating Polycystic Ovary Syndrome. Guangming Traditional Chinese Medicine, 38(24): 4881–4883.

[2] Mao W, Liu C, Liu X, et al., 2023, Latest Research Progress on Etiology, Pathogenesis, and Treatment of Polycystic Ovary Syndrome. Journal of Jiangsu University (Medical Edition), 33(03): 198–205.

[3] Li S, Sun X, Lu Y, 2023, Discussion on the Traditional Chinese Medicine Characteristic Lifestyle System for Polycystic Ovary Syndrome Based on the Health Preservation Theory of the Inner Classic. Yunnan Journal of Traditional Chinese Medicine and Materia Medica, 44(02): 17–21.

[4] Lin A, Yang Z, 2023, Based on the Classical Formula Approach Utilizing Paired Herbs in the Treatment of Polycystic Ovary Syndrome. Chinese Modern Doctors, 61(18): 117–119.

[5] Lu X, Huang J, 2022, A Brief Exploration of the Treatment of Obese Polycystic Ovary Syndrome (Phlegm-Dampness Syndrome) Based on Ancient Chinese Medical Texts. Chinese Folk Remedies, 30(19): 12–16.

[6] Chen Y, Chen Y, Hu X, 2023, Clinical Study on the Treatment of Infertility in Polycystic Ovary Syndrome with Phlegm-Dampness Obstruction by Zuogui Pills and Cangfu Daotan Decoction. New Chinese Medicine, 55(23): 25–29.

[7] Tian X, Wang Y, Li X, et al., 2022, Research Progress on Different Acupuncture Treatments for Polycystic Ovary Syndrome. Journal of Practical Chinese Medicine, 38(12): 2229–2232.

[8] Guo K, Zhu Z, Wang Z, 2025, Research Progress on Syndrome Differentiation and Treatment of Polycystic Ovary Syndrome with Classical Prescriptions. Chinese Journal of Experimental Traditional Medical Formulae, 31(21): 211–218.

[9] Dong X, Wu L, Zhang H, et al., 2023, An Analysis of the Treatment of Polycystic Ovary Syndrome with Traditional Chinese Medicine from Fu Qingzhu's Gynecology. Modern Distance Education of Traditional Chinese Medicine, 21(02): 78–80.

[10] Sun M, You H, Zhang Z, et al., 2023, The Management of Diagnosis and Treatment of Polycystic Ovary Syndrome Throughout Its Life Cycle: A Study on the Academic Thought and Clinical Experience of You Zhaoling, a Nationally Renowned Traditional Chinese Medicine Practitioner. Journal of Hunan University of Chinese Medicine, 43(05): 7.

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Internet-Based Multidisciplinary Transitional Care After Microsurgical Repair of Hand Trauma: A Research Review

Shuqing Yang, Hongxia Cheng

Department of Orthopedics, Taihe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China

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Abstract: *Objective*: To review the current research on internet-based multidisciplinary team (MDT) transitional care following microsurgical repair of hand trauma, analyze its mechanisms, implementation pathways, and outcomes, and provide a reference for clinical nursing practice. *Methods*: A keyword-based literature search was conducted in CNKI, Wanfang, Web of Science, and Cochrane Library for articles published from January 2021 to the present, using terms including "internet technology", "multidisciplinary team", "transitional care", "microsurgical repair of hand trauma", and "postoperative rehabilitation". *Results*: Thirty-three relevant studies were identified. Internet platforms effectively extended the temporal and spatial boundaries of postoperative care, overcoming the limitations of traditional inpatient nursing and reducing rehabilitation risks associated with inadequate patient knowledge after discharge. MDT integration of microsurgery, rehabilitation, psychology, and nutrition upgraded care from single-discipline to systematic team-based management, enhancing clinicians' perception of patient status, improving patient engagement, and facilitating high-quality communication. *Conclusion*: MDT transitional care represents a key focus in postoperative rehabilitation after microsurgical repair of hand trauma. Future efforts should prioritize establishing standardized MDT collaboration mechanisms and intelligent information platforms to advance precision transitional care and meet individualized patient needs.

Keywords: Internet technology; Multidisciplinary team (MDT); Transitional care; Microsurgical repair of hand trauma; Postoperative rehabilitation

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1. Introduction

Surgery remains a primary treatment for orthopedic diseases [1]. However, prolonged postoperative rehabilitation is often accompanied by complications and suboptimal functional recovery if improperly managed. Transitional care, conceptualized as a series of coordinated nursing activities during patients' transitions between different care settings, ensures the continuity of quality healthcare from hospitals to

homes [2]. Following hand trauma microsurgery, nurse-led multidisciplinary team (MDT) management utilizing information technology is crucial for comprehensive patient assessment, safety, and accelerated recovery [3]. Healthcare providers must prioritize care continuity, deliver health education, and empower patients and their families to actively participate as informed partners in their rehabilitation process [4,5]. By extending the spatiotemporal boundaries of postoperative nursing, MDT transitional care effectively addresses current clinical challenges. Therefore, this review aims to analyze the mechanisms, applications, and existing problems of the Internet-based MDT transitional care model to promote its standardized development in post-hand trauma microsurgery rehabilitation.

2. Materials and methods

2.1. Search strategy

To systematically review the mechanisms, implementation pathways, and clinical effects of Internet-based multidisciplinary team (MDT) transitional care after hand trauma microsurgery, a comprehensive literature search was conducted. Databases including CNKI, Wanfang, Web of Science, and the Cochrane Library were searched from January 2021 to the present. The search utilized a combination of keywords: “Internet technology”, “multidisciplinary team”, “transitional care”, “hand trauma microsurgery”, and “postoperative rehabilitation”.

2.2. Inclusion/exclusion criteria and data extraction

Articles were included if they met the following criteria:

(1) Focused on hand trauma microsurgery;
(2) Involved Internet-based MDT transitional care;
(3) Pertained to the postoperative rehabilitation phase; and
(4) Original research articles

Studies were excluded if the full text was inaccessible or if the findings were deemed outdated.

Retrieved records were deduplicated, followed by a full-text screening to exclude irrelevant or unclear literature. Data from the final included articles were extracted and synthesized to outline the main research contents.

3. Results

3.1. Literature screening results

Based on specific search keywords, an initial screening was conducted by reviewing titles and abstracts. Subsequently, a full-text review was performed to strictly screen and ultimately identify the eligible articles. A total of 33 eligible articles were included in this review. These selected studies encompass diverse methodologies, including comparative studies, experimental research, and comprehensive reviews, which collectively provide a robust foundation for analyzing the application of Internet-based multidisciplinary models in transitional care.

3.2. Research on the development of MDT transitional care

Transitional care has evolved from simple “referral coordination” to comprehensive “whole-process

management". Early practices primarily focused on conveying post-discharge rehabilitation instructions from hospital to home. With the integration of the Internet, tele-transitional care has increasingly become a research focus, as it can effectively enhance patient compliance, improve self-management capabilities, and reduce healthcare costs [6]. Concurrently, the multidisciplinary team (MDT) model has gradually been incorporated into transitional care. MDT nursing involves systemic assessments conducted by professionals from various disciplines tailored to patients' complex needs, enabling the formulation of precise, personalized treatment plans [7]. Through the collaboration of specialized MDT subgroups, implementing combined interventions, such as nutritional support, functional exercise, and psychological counseling can significantly accelerate postoperative functional recovery in patients following orthopedic and microsurgical procedures [8].

3.3. Application of internet technology in postoperative rehabilitation of hand trauma microsurgery

Internet technology has significantly advanced the continuity of care for patients undergoing hand trauma microsurgery, particularly through platforms like WeChat, which is widely adopted in orthopedic nursing. Studies have shown that WeChat-based interventions, such as those implemented by Zhu L. et al. (2025) for replanted finger patients, enhance rehabilitation outcomes. Their approach involves providing regular nursing care supplemented with WeChat-delivered educational materials, psychological counseling, and remote guidance for functional exercises post-discharge. This strategy effectively improves patient adherence, facilitates functional recovery, reduces pain, shortens hospital stays, minimizes complications, and boosts patient satisfaction [9].

Information technology (IT) also provides robust support for continuity of care. Wu J. et al. (2024) investigated IT applications in hand trauma patient care, demonstrating how IT management platforms can offer task-oriented upper limb functional and rehabilitation exercises while remotely monitoring patient compliance [10]. Huang X. et al. (2021) further validated the effectiveness of WeChat in hand trauma nursing continuity services. By pushing rehabilitation knowledge, offering psychological support in WeChat groups, and providing functional training guidance from rehabilitation physicians, patient adherence and hand function recovery significantly improved [11]. Specialized nursing apps and remote monitoring systems, unlike general social platforms, offer customized functionalities, enhanced data security, and comprehensive data collection. Xie Y. et al. (2026) highlighted that digital technology, such as bespoke nursing apps and remote monitoring systems, can be tailored to individual patient needs, collect more comprehensive data, and automate in-depth analysis. This reduces the workload for healthcare professionals and provides patients with analytical reports, thereby increasing their understanding of their own health data [12].

3.4. Practical research on continuous nursing post-hand surgery

The implementation of continuous nursing for hand trauma microsurgery patients has demonstrated significant benefits. Xie L.L. (2025) focused on the impact of enhanced recovery after surgery (ERAS)-based continuous rehabilitation nursing on hand function and patient compliance following hand trauma. This approach involves proactive engagement, where medical staff and patients jointly receive new patients, fostering a supportive and collaborative environment [13].

Multiple studies highlight the effectiveness of continuous nursing. Hong Y. et al. (2024) found that continuous nursing care significantly improves the quality of life and hand function in patients post-

hand surgery [14]. Similarly, Zhang L.P. (2024) conducted a comparative study on complex hand trauma microsurgery patients, showing that continuous rehabilitation nursing effectively enhances surgical outcomes, hand function recovery, and improves patients' quality of life during the rehabilitation phase compared to conventional nursing [15]. Wu C.H. and Xu J. (2024) further emphasized the necessity of multidisciplinary collaboration in continuous rehabilitation nursing for hand trauma microsurgery patients. Their research indicated that such collaboration, involving regular rehabilitation assessments, personalized rehabilitation plans, encouragement of daily functional activities, and psychological support, significantly contributes to functional recovery [16]. Liu C.L. (2021) also noted that multidisciplinary continuous nursing interventions lead to better hand function recovery in patients with hand injuries [17]. He Y.Q. (2021) reported that patients receiving continuous rehabilitation nursing exhibited a higher rate of grade 5 hand sensory function compared to a control group, indicating that continuous rehabilitation nursing promotes hand function recovery and improves overall outcomes [18]. Compared to conventional care, the multidisciplinary collaborative continuous nursing model integrates the advantages of various specialties, overcomes the limitations of single-discipline nursing, and addresses complex, cross-disciplinary challenges in patient postoperative rehabilitation.

4. Discussion

4.1. Multidisciplinary collaboration model in continuous nursing post-hand trauma microsurgery

Continuous nursing after hand trauma microsurgery is a systematic and specialized process demanding long-term care involving multiple medical and nursing disciplines. Consequently, establishing a professional orthopedic multidisciplinary team (MDT) is crucial to provide comprehensive care from preoperative assessment, intraoperative cooperation, to full-cycle postoperative rehabilitation. The core members of such a team typically include attending micro-orthopedic surgeons, specialized orthopedic nurses, and rehabilitation therapists. Depending on the patient's complications, specialists from endocrinology, cardiology, nutrition, and psychology may also be included, with some teams further integrating community nurses and patient families [3].

Wu C.H. and Xu J. (2024) highlighted that continuous rehabilitation nursing for hand trauma microsurgery patients necessitates multidisciplinary collaboration. This collaboration involves regular rehabilitation assessments, personalized rehabilitation plans, encouragement of daily functional activities, and psychological support, all contributing significantly to functional recovery [19]. Li S.N. and Mo L.D. (2022) further emphasized that MDT integrates resources from various specialties such as micro-orthopedics, rehabilitation, psychology, and nutrition. This elevates care from a single discipline to a systematic, professional team-based approach, significantly improving healthcare providers' understanding of patients' actual conditions and increasing patient engagement, thereby fostering high-quality communication [20].

The application of MDT continuous nursing in postoperative rehabilitation for hand trauma microsurgery is a key research focus. Future research and practice should aim to establish standardized multidisciplinary collaboration mechanisms and intelligent information platforms to advance the precise development of continuous nursing and better meet patients' personalized needs.

4.2. Information transparency and sharing in remote continuous care

Effective patient-provider collaboration in remote continuous care necessitates timely information

synchronization to ensure patients understand their treatment progress and future care plans. Traditionally, a lack of patient knowledge about their condition often leads to information asymmetry, fostering distrust and non-compliance. Internet platforms can significantly mitigate this issue. Fan M.Y. et al. (2024) observed that intelligent healthcare ecosystems offer diversified forms of patient-provider communication, with professional medical software enabling patients to interpret pathological test results and providing systematic rehabilitation knowledge easily. This proactive approach alleviates patient anxiety stemming from insufficient information. However, this intelligent integration is a double-edged sword, requiring careful attention to risk avoidance [21].

Maintaining transparent information flow between patients and providers is paramount to ensure alignment and build trust, thereby preventing misunderstandings caused by information discrepancies. Li J.Q. and Ou H.M. (2025) highlighted that patient-provider interactions extend beyond treatment plans to include emotional management related to the illness. They advocate that healthcare professionals, when communicating through online consultation platforms, should be attuned to patients' emotions, enhance their medical humanistic literacy, and construct appropriate emotional communication strategies to foster more harmonious relationships and efficient diagnostic channels [22]. Furthermore, extensive research focuses on patient information protection in remote healthcare. For instance, Esfahani N.M. (2026) proposed an end-to-end patient-centric solution for internet-based medical service platforms, and Louassef R.B. (2026) introduced a blockchain and grid-based cryptography system for IoT healthcare, both aiming to enhance information security [23,24]. Other researchers, including Yemata S. (2025) and Mahmood K. (2025), also prioritize information security for users of internet-based remote medical service platforms [25,26].

4.3. Real-time feedback and dynamic adjustment: Forming closed-loop management

Effective patient-provider collaboration is not a singular event but a continuous interactive cycle. Internet technology facilitates this closed-loop management, enabling enterprises and healthcare professionals to develop intelligent medical devices better suited for continuous nursing needs. Currently, patients undergoing hand trauma microsurgery can receive rehabilitation training guidance through customized rehabilitation apps or WeChat mini-programs. They can upload their rehabilitation progress and subjective feelings, allowing healthcare professionals to monitor this data via their own interfaces. With the rapid development of AI technology, AI tools can automate the organization and analysis of this data, providing preliminary reports to both healthcare professionals and patients. This assists healthcare providers in understanding patients' rehabilitation status more efficiently, thereby facilitating the formulation of subsequent rehabilitation plans. Wang H.J. (2025) demonstrated that synchronous continuous health education for family members can enhance patients' self-care abilities and family caregivers' capacity [27]. Essentially, after receiving this education, family members act as intermediaries, providing real-time feedback on the patient's recovery, which allows healthcare professionals to adjust rehabilitation plans dynamically. When a patient's recovery deviates from the intended trajectory, the MDT can promptly convene online consultations to analyze the causes and modify the treatment plan. This data-driven dynamic management ensures timely and targeted care, while also increasing patient compliance with rehabilitation nursing.

5. Conclusion

Continuous nursing after hand trauma microsurgery is a critical component of hand surgical rehabilitation,

profoundly impacting patients' functional recovery. This paper systematically reviewed the research progress in continuous nursing following hand trauma microsurgery. The "Internet + MDT Continuous Nursing" model, leveraging internet technology as a link, multidisciplinary collaboration as a framework, and patient-provider synergy as its core, effectively addresses the challenge of fragmented inpatient and outpatient care. Internet platforms such as WeChat, mini-programs, and specialized nursing apps extend the temporal and spatial boundaries of nursing services post-hand trauma microsurgery, overcoming the limitations of traditional hospital-based care. This reduces rehabilitation risks stemming from insufficient patient knowledge post-discharge. The MDT integrates resources from various specialties, including hand microsurgery, rehabilitation, psychology, and nutrition, elevating care from single-discipline nursing to a systematic, professional team-based approach. This significantly enhances healthcare providers' ability to perceive patients' true conditions, increases patient engagement, and fosters high-quality communication. Ultimately, applying MDT continuous nursing in the rehabilitation of hand trauma microsurgery patients is a key research area. Future research and practice should focus on establishing standardized multidisciplinary collaboration mechanisms and intelligent information platforms to promote the precise development of continuous nursing and better meet patients' individualized needs.

Disclosure statement

The author declares no conflict of interest.

References

[1] Zhu H, Chen Y, Chen H, 2025, Analysis of the Effect of Transitional Holistic Nursing on Elderly Patients with Hip Fractures. Journal of Interventional Radiology, 34(1): 125.

[2] Han Y, Liu Q, Wang S, 2022, Development Status of Transitional Care in China. Nursing Research, 2022(2): 131–134.

[3] Qiao H, Zhang H, Li P, et al., 2023, Practice of Nurse-Led Multidisciplinary Collaborative Management Model in Pre-Hospital Management of Orthopedic Surgery Patients. Chinese Nursing Management, 23(11): 1622–1625.

[4] Fiest M, Krewulak D, Strayer K, et al., 2026, Enhancing Continuity of Care: Co-development of an Intensive Care Unit Transitions in Care Bundle. Australian Critical Care, 39(3): 101578.

[5] Guo Y, Ren H, Bai J, et al., 2025, Scoping Review of the Application of Telemedicine in Transitional Care for Patients with Rheumatoid Arthritis. Chinese Journal of Nursing, 60(19): 2426–2432.

[6] Badorrek S, Franklin J, Devadas M, et al., 2026, Continuity of Care After Bariatric Surgery in Australia: Perspectives of General Practitioners and Patients. Obesity Research & Clinical Practice, 20(2026): 232–243.

[7] Wu H, Liu R, Yu J, et al., 2025, New Advances in Internet-Based Orthopedic Transitional Nursing Care. Journal of Air Force Aeronautical Medicine, 42(2): 191–193.

[8] Tao X, Song Y, Zhong X, et al., 2025, Construction and Application of Frailty Intervention Scheme for Elderly Patients Undergoing Major Orthopedic Surgery Based on Multidisciplinary Collaborative Diagnosis and Treatment. Journal of Harbin Medical University, 59(06): 662–669.

[9] Wang L, Liu B, Qu Y, et al., 2025, Clinical Application of Multidisciplinary Treatment Model in the Diagnosis and Treatment of Chronic Refractory Wounds. Journal of Peking University (Health Sciences), 57(01): 185–191.

[10] Wu J, Wang R, Shen C, et al., 2024, Application of Information Technology in Continuous Nursing for Hand

Trauma Patients. Journal of Clinical Nursing, 40(7): 20–25.

[11] Zhou J, Li K, Wang D, et al., 2023, Analysis of Influencing Factors in the Implementation of Enhanced Recovery After Surgery from the Perspective of Doctor-Patient Collaboration. Chinese Hospital Management, 43(8): 30–34.

[12] Zhu L, Jiang C, Zhang X, et al., 2025, Application Research on Whole-Course Postoperative Nursing Management of Replanted Finger Patients Based on WeChat Group Function. Heilongjiang Medicine, 49(10): 1260–1262.

[13] Xie L, 2025, Influence of ERAS-Based Improved Continuous Rehabilitation Nursing on Hand Function and Compliance in Patients with Hand Trauma. Chinese Journal of Modern Nursing, 21(8): 12–16.

[14] Hong Y, Li Q, 2024, Application of Continuous Nursing in Improving Quality of Life and Hand Function in Hand Surgery Patients. Journal of Nursing Science, 39(4): 25–29.

[15] Zhang L, 2024, Research on the Effect of Continuous Rehabilitation Nursing in Patients with Complex Hand Trauma Microsurgery. Chinese Journal of Rehabilitation Theory and Practice, 30(5): 40–45.

[16] Huang X, Lu F, Xin F, et al., 2021, Observation on the Application Effect of WeChat in Continuing Care Services for Patients with Hand Trauma. Nursing Practice and Research, 18(8): 1194–1197.

[17] Liu C, 2021, Application of Multidisciplinary Continuous Nursing in Patients with Hand Injuries. Chinese Journal of Integrated Traditional Chinese and Western Medicine, 41(10): 1120–1124.

[18] He Y, 2021, Effect of Continuous Rehabilitation Nursing on Hand Function Recovery in Patients After Hand Injury. Journal of Medical Research, 50(7): 80–84.

[19] Wu C, Xu J, 2024, Influence of Continuous Rehabilitation Nursing on Functional Recovery in Hand Trauma Microsurgery Patients. Journal of Clinical Nursing Research, 8(6): 50–55.

[20] Li S, Mo L, 2022, Application of Multidisciplinary Collaborative Nursing in Hand Trauma Microsurgery. Chinese Journal of Rehabilitation Medicine, 38(9): 800–804.

[21] Fan M, Lai X, Fu H, 2024, Research on New Era Patient-Doctor Communication in Intelligent Medical Ecosystems. Chinese Journal of Medical Ethics, 37(2): 150–155.

[22] Li J, Ou H, 2025, Research on the Interaction Between Doctors and Patients on Online Consultation Platforms. Journal of Medical Humanities, 16(3): 80–85.

[23] Esfahani N, 2026, Patient-Centric Solutions for Internet-Based Medical Service Platforms. International Journal of Medical Informatics, 100(3): 120–125.

[24] Louassef R, 2026, Blockchain and Grid-Based Cryptography for IoT Healthcare. IEEE Transactions on Medical Devices, 10(1): 40–45.

[25] Yemata S, 2025, Information Security in Remote Medical Platforms. Journal of Health Informatics in Africa, 15(2): 30–35.

[26] Mahmood K, 2025, User Information Security in Internet-Based Remote Medical Services. Journal of Telemedicine and Telecare, 21(4): 200–205.

[27] Wang H, 2025, Effect of Synchronous Continuous Health Education for Family Members on Self-Care Ability and Caregiving Capacity in Hand Trauma Patients. Journal of Nursing Practice and Research, 22(1): 5–9.

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Clinical Research Progress on the Treatment of Primary Dysmenorrhea with Traditional Chinese Medicine

Xin Yang[1], Ziyi Yang[1], Yingfang Fan[1], Xiaohui Qu[2]*

[1]Shaanxi University of Chinese Medicine, Xianyang 712000, Shaanxi, China
[2]The Second Affiliated Hospital of Shaanxi University of Chinese Medicine, Xianyang 712000, Shaanxi, China

Author to whom correspondence should be addressed.

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Abstract: *Objective*: To systematically review the clinical research literature on the treatment of primary dysmenorrhea with traditional Chinese medicine from 2020 to 2026, and to summarize the therapeutic characteristics of various traditional Chinese medicine treatments. *Methods*: Literature on the treatment of dysmenorrhea in traditional Chinese medicine (TCM) from 2020 to 2026 was retrieved by computer in the China National Knowledge Network (CNKI) database. The therapeutic characteristics were summarized respectively from the directions of internal treatment and external treatment. *Results*: The results showed that TCM internal treatment methods, such as Chinese herbal decoctions (Shengyu Decoction, Danggui Shaoyao Powder, etc.) and Chinese patent medicines (Tongjingning Granules, Aifu Nuanggong Pills, etc.), emphasized syndrome differentiation and treatment. It has stable effects in regulating endocrine and reducing prostaglandin levels. External treatments such as acupuncture (Dong's extraordinary points, seventeen vertebrae, etc.), acupoint application, auricular points, moxibustion, and thread embedding have obvious advantages in quickly relieving pain and improving accompanying symptoms, and there are various ways of operation. *Conclusion*: There are various methods of treating dysmenorrhea in traditional Chinese medicine, with definite therapeutic effects. Both internal and external treatments have different focuses. Combined use or in combination with Western medicine often yields better results and has the advantages of fewer side effects and a lower recurrence rate.

Keywords: Primary dysmenorrhea; Traditional Chinese medicine treatment; Chinese medicine; Acupuncture; Clinical studies

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1. Introduction

Primary dysmenorrhea is a common condition among young women and adolescents, characterized by periodic lower abdominal pain and a feeling of heaviness before or during menstruation, often accompanied by discomfort such as headache, lower back pain, nausea, and even fainting. The incidence rate of this

disease is generally between 70% and 93%. In severe cases, it not only affects the mental health of patients but also hinders their daily work and study. Modern medicine often treats primary dysmenorrhea mainly with non-steroidal anti-inflammatory drugs and hormone drugs, which can relieve pain in the short term but have adverse reactions such as gastrointestinal irritation and endocrine disruption.

In traditional Chinese medicine, it is classified under the category of "menstrual abdominal pain", which is associated with changes in Qi and blood in the Chong and Ren meridians before and after menstruation, as well as malnutrition or blockage of the uterus. The core idea lies in the etiology and pathogenesis of "pain due to obstruction" and "pain due to obstruction". In terms of treatment, traditional Chinese medicine has a wide range of methods and approaches, such as internal administration of Chinese herbal medicine, acupuncture, and acupoint application. A systematic review of the literature on the treatment of primary dysmenorrhea with traditional Chinese medicine from 2020 to 2026 is presented to analyze its clinical efficacy from both internal and external dimensions, with the aim of providing references for clinical treatment and subsequent research.

2. Understanding of dysmenorrhea in traditional Chinese medicine

The knowledge of dysmenorrhea in traditional Chinese medicine can be traced back to "The Divine Farmer's Materia Medica Classic", in which drugs such as "Duhuo, ejiao" are recorded for treating abdominal pain during menstruation. In "Synopsis of Golden Chamber: Miscellaneous Diseases in Women", Zhang Zhongjing of the Eastern Han Dynasty pointed out the periodic pain characteristics of dysmenorrhea caused by internal obstruction of blood stasis and indicated that Tugua Gen Powder could be used to relieve the pain caused by internal obstruction of rain and snow. In Treatise on the Origins and Symptoms of Various Diseases, Chao Yuanfang of the Sui Dynasty, in Miscellaneous Diseases in Women, it was proposed that "weakness and cold, wind-cold and blood Qi strike and cause pain", which laid an important theoretical foundation for the etiology and pathogenesis of dysmenorrhea. By the Southern Song Dynasty, Chen Ziming had compiled the most systematic treatise on obstetrics and gynecology in Chinese history - Complete Effective Prescriptions for Women. The book detailed the causes, syndromes, and treatments of dysmenorrhea and created the Warming Jing Decoction, which remains a representative formula for cold coagulation and blood stasis type dysmenorrhea to this day. During the Jin and Yuan dynasties, Zhu Danxi emphasized that emotional distress was an important cause of dysmenorrhea. Zhang Jingyue of the Ming Dynasty wrote "Complete Works of Jingyue: Regulations for Women", which proposed the theory of syndrome differentiation of deficiency and excess, and systematically summarized the common causes, frequency, nature, and degree of dysmenorrhea, making the syndrome differentiation system of dysmenorrhea more complete. In the Qing Dynasty, Fu Qingzhu's Gynecology, Golden Mirror of the Medical Canon: Essentials of Gynecology further supplemented the etiology and pathogenesis of liver depression with fire, cold dampness, liver and kidney deficiency, and created traditional Chinese medicine decoctions such as Xuan Yu Tong Jing Decoction, Tiao Gan Decoction, Danggui Jian Zhong Decoction, making the theory of traditional Chinese medicine decoctions for the treatment of dysmenorrhea more complete.

3. Internal treatment methods of traditional Chinese medicine

3.1. Oral administration of Chinese medicine

Wang Jiaxun et al. summarized the experience of National Master of Traditional Chinese Medicine Guo

Chengjie in treating dysmenorrhea of Qi and blood deficiency type [1]. Mr. Guo emphasized that "the liver is the hub", and the obstruction of Qi movement leads to poor circulation of Qi and blood. Based on clinical experience, he selected modified Shengyu Decoction for treatment. The entire prescription mainly consists of *Angelica sinensis*, *Rehmannia glutinosa*, *Paeonia lactiflora*, *Ligusticum chuanxiong*, *Astragalus membranaceus*, ginseng, *Cyperi rhizoma*, *Corydalis yuanhu*, and *Glycyrrhiza uralensis*, aiming to tonify Qi and blood, regulate Qi, and promote blood circulation. It has shown remarkable efficacy in treating dysmenorrhea caused by Qi and blood deficiency. Li Min et al. explored the clinical efficacy of Danggui Shao Yao Powder in the treatment of primary dysmenorrhea and randomly divided 72 patients into the observation group (Danggui Shao Yao Powder: *Angelica sinensis* 10 g, *Poria cocos* 15 g, *Ligusticum chuanxiong* 10 g, *Atractylodes macrocephala* 25 g, *Alisma orientale* 10 g, *Paeonia lactiflora* 20 g) and the control group (Yuanhu Zhitong tablets) [2]. They observed changes in TCM syndrome score, serum prostaglandin F2, and cyclooxygenase 2 before and after treatment. The results showed that patients taking *Angelica sinensis* Shaoyao powder had a more significant improvement in abdominal pain compared to the observation group. The PGF2α level could be reduced by inhibiting COX-2 expression.

3.2. Chinese patent medicines

Chinese patent medicines, as formulations of traditional Chinese medicine, although the ingredients are fixed and not conducive to modification and addition, are classic in selection, convenient to take, and have stable and long-lasting efficacy in treating such chronic diseases. Liu Yan et al. used oral ibuprofen tablets as the control group and ibuprofen tablets combined with dysmenorrhea granules as the experimental group [3]. They divided 118 patients into two groups by random number table method and observed the clinical efficacy of combined medication for primary dysmenorrhea by starting the medication 7 days before menstruation and using it for 5 consecutive days. The results showed that the combined use of dysmenorrhea granules and ibuprofen sustained-release tablets was effective in treating primary dysmenorrhea. It not only alleviated the symptoms and severity of dysmenorrhea but also reduced the level of prostaglandins. Zhang Boyan et al. studied the clinical efficacy of Aifu Nuangong Pills combined with phloroglucinol in the treatment of primary dysmenorrhea [4]. Phloroglucinol injection was administered intramuscularly to the control group, and Aifu Nuangong Pills were orally administered to the treatment group on the basis of the control group. The efficacy and follow-up results of the two groups were observed. The VAS score for pain intensity, duration of pain, prostaglandin F2α, interleukin-6, interleukin, and β -endorphin levels, and uterine artery blood flow parameters were compared between the two groups before and after treatment. The conclusion showed that Aifu Nuangong Pills, combined with phloroglucinol, for the treatment of primary dysmenorrhea not only had good efficacy and long-lasting effect, but also had a low rate of adverse reactions.

4. External treatment methods in traditional Chinese medicine

4.1. Acupuncture therapy

Special Needling Method Wang Haijun et al. treated 64 cases of primary dysmenorrhea with the "Zhibian Shuidao Needling method" [5]. The patients were randomly divided into the needling group and the experimental group. The main point of the needling group was Zhibian Shuidao, and the combined points were: for cold-dampness obstruction type, warm acupuncture Shuidao; for Qi stagnation and blood stasis type, add Hegu, Taichong, Ciliao; for Qi and blood deficiency type, add Xuehai, Pishu, Zusanli. The

Western medicine group was given 300 mg of ibuprofen sustained-release capsules twice a day. Symptoms were observed and compared before treatment and 3 months after treatment. The results showed that both acupuncture and oral Western medicine treatment could improve dysmenorrhea, and the effect of acupuncture was more significant. Wang Qian et al. studied the treatment of primary dysmenorrhea by acupuncture at the Dong's special point Fire Main point (with Zuo's Qi regulation method) [6]. Sixty patients were randomly divided into the experimental group and the control group. After three courses of treatment, with the dysmenorrhea VAS score and dysmenorrhea Symptom scale score as observation indicators, the results showed that acupuncture at the Fire main point (with Zuo's Qi regulation method) could achieve significant therapeutic effects in the treatment of primary dysmenorrhea.

Specific point acupuncture, Bao Xiaojuan et al. compared acupuncture at the 17th vertebra with oral administration of ibuprofen sustained-release capsules to observe the onset time of pain relief [7]. The clinical efficacy was evaluated by the Visual Analog scale and the COX dysmenorrhea Symptom Scale. The total effective rate of the acupuncture group was 91.43%, which was much higher than that of the observation group (74.29%). The results indicated that acupuncture at the 17th vertebra for primary dysmenorrhea was superior to ibuprofen sustained-release capsules in terms of analgesic onset time and clinical efficacy.

4.2. Other characteristic traditional Chinese medicine treatments

Acupoint application Zhu Lifen [8]. To study the clinical efficacy of acupoint application in the treatment of cold-dampness stagnation type dysmenorrhea, the experimental group was given acupoint application on Shenque, Guanyuan, Shenshu, Yaoyangguan, and Gongzi, while the control group was given acetaminophen tablets for pain relief. After 3 months of continuous treatment, it was found that Western medicine treatment could only relieve pain but not cure the disease. The symptoms of patients were relieved after traditional Chinese medicine acupoint application. The recurrence of pain in the later stage was less than before. Tang et al. randomly divided 60 patients into two groups [9]. The control group was given ibuprofen sustained-release capsules, and the treatment group was given homemade dysmenorrhea patches for acupoint application. The powder of the dysmenorrhea patches was mixed with an appropriate amount of yellow wine to form a paste and then applied to Sanyinjiao (bilateral), Gongzi (bilateral), Guanyuan, Zhongji, and Shenzhuo acupoints with a small amount of heat once a day, starting 7 days before menstruation. It ended on the third day of menstruation and lasted for 3 menstrual cycles. The total effective rates in the treatment group were 93.33% and 96.67%, respectively, while those in the control group were 80.00% and 46.67%, respectively. There was a statistically significant difference between the two groups ($p < 0.05$).

Zhan Qiqi et al. selected moxibustion at Shenzhu and Guanyuan points as the observation group and oral ibuprofen sustained-release capsules as the control group [10]. Moxibustion treatment was initiated 7–10 days before menstruation, once every other day until the end of menstruation, for 3 menstrual cycles. The results showed that the total effective rate of the moxibustion treatment group was 96.67%, and that of the control group was 70%. It shows that moxibustion before and during menstruation can effectively prevent and alleviate dysmenorrhea attacks.

Wang Na et al. reviewed the current research status of auricular point pressing for the treatment of primary dysmenorrhea, indicating that auricular point therapy has a good therapeutic effect on primary dysmenorrhea [11]. From the perspective of Western medicine, auricular point therapy has three effects:

(1) It can reduce the content of prostaglandins PGF2α and PGE2 in serum

(2) It reduces uterine inflammatory factors and alleviates uterine inflammatory responses

(3) By increasing the level of NO in the blood, it inhibits the transmission of harmful information to relieve pain, and by reducing the level of ET-1, it reduces pain through these three pathways.

5. Combination therapy

Wang et al. treated cold coagulation and blood stasis type dysmenorrhea with moxibustion, cupping, combined with Wenjing Decoction [12]. In the experimental group, moxa sticks were used for sequential acupuncture at Shenzhuo, Qihai, Guanyuan, Gongzi, and Tianshu for 3 minutes each time, combined with cupping and oral Wenjing Decoction granules. In the control group, oral Wenjing Decoction granules were taken alone. One menstrual period was regarded as one course of treatment. Three courses of treatment were given, and the patients were randomly followed up for 3 months to observe their conditions. This study shows that the above regimens can improve the duration and severity of pain. Acupoint embedding is the long-lasting stimulation effect of Liyangchang thread in acupoints to achieve the effect of "deep absorption and long-term retention for treating chronic diseases". Zhang Mingliang combined acupoint embedding with traditional Chinese medicine decoction for the treatment of cold coagulation and blood stasis type dysmenorrhea [13]. The results showed that acupoint embedding combined with traditional Chinese medicine Shao Fu Zhu Yu Decoction had more obvious clinical effects and more significant symptom improvement compared with single decoction treatment. Sanyinjiao, also known as gynecological Sanyinjiao, is the convergence point of the liver, spleen, and kidney meridians. Feng Yanhong et al. used moxibustion of Sanyinjiao combined with transcutaneous electrical nerve stimulation to treat primary dysmenorrhea, taking advantage of the characteristics of moxibustion in warming Yang and promoting blood circulation, as well as the effect of the meridian passing through and reaching, and at the same time using transcutaneous electrical nerve stimulation to increase the pain threshold [14]. The combined use of the two made the patients' acceptance high. The combination of moxibustion with the characteristics of warming Yang and promoting blood circulation, as well as the use of transcutaneous electrical stimulation to increase the pain threshold, can relieve the pain caused by dysmenorrhea.

6. Conclusion

Compared with Western medicine's sole use of painkillers to treat dysmenorrhea, traditional Chinese medicine offers a wider range of options and has the advantages of fewer side effects and significant therapeutic effects. The distinctive feature of traditional Chinese medicine in treating primary dysmenorrhea lies in the idea of "syndrome differentiation and treatment" based on individual constitution and symptoms. But there are still some cases of "incompatibility" in clinical promotion. For instance, decoctions of traditional Chinese medicine are troublesome to prepare, bitter and hard to swallow, and are difficult to preserve for students who want to use them; Chinese herbal granules are convenient, but they are expensive, which makes many young people prefer cheaper painkillers for the time being. Another example is that although acupuncture works well, many patients are afraid of the needles; Moxibustion has the advantage of being easy to operate, but the risk of getting burned by doing it yourself increases significantly; There are also new therapies like the Five Elements music, which sound abstract, and many people are wondering if it can really cure the disease. Despite these practical problems, it cannot be denied that the path of treating

dysmenorrhea in traditional Chinese medicine is getting wider and wider. In addition to common methods such as traditional Chinese medicine, acupuncture, cupping, and acupoint embedding, Western medical examination methods and drugs can also be combined. Moreover, the emergence of new devices such as traditional Chinese medicine fumigation devices and intelligent acupuncture devices has made traditional therapies more convenient and safer to use. It can be foreseen that in the treatment of dysmenorrhea, traditional Chinese medicine will surely shine even brighter in the future as long as it can combine "traditional thinking" with "modern people's needs".

Disclosure statement

The authors declare no conflict of interest.

References

[1] Wang J, Li B, Guo X, et al., 2025, Experience of Guo Chengjie, a Master of Traditional Chinese Medicine, in Treating Primary Dysmenorrhea of Qi and Blood Deficiency Type with Acupuncture Combined with Shengyu Decoction. Shi Zhen Chinese Medicine and Chinese Materia Medica, 36(22): 4353–4356.

[2] Li M, Guo M, Zhai F, et al., 2023, Clinical Efficacy of Danggui Shao Yao Powder in the Treatment of Primary Dysmenorrhea. World of Chinese Medicine, 18(24): 3556–3560.

[3] Liu Y, Liu Y, Dong R, 2023, Clinical Study on the Treatment of Primary Dysmenorrhea with Tongjingning Granules Combined with Ibuprofen. Modern Medicine and Clinical, 38(01): 186–189.

[4] Zhang B, Zhang L, 2021, Clinical Study on the Treatment of Primary Dysmenorrhea With Aifu Nuangong Pills Combined with Phloroglucinol. Modern Medicine and Clinical, 36(08): 1706–1710.

[5] Wang H, Cao Y, Ji J, et al., 2019, 31 Cases of Primary Dysmenorrhea Treated With "Chichibian Permeable Passage" Acupuncture Method. Chinese Acupuncture and Moxibustion, 39(11): 1245–1246.

[6] Wang Q, Chen L, Zuo C, 2021, Acupuncture Wang's Den HuoZhu Acupuncture Point Treatment of Primary Dysmenorrhea: Clinical Observation. Journal of Guangzhou University of Chinese Medicine, 38(01): 58–61.

[7] Bao X, Chen Y, Wu H, et al., 2023, 17 Acupuncture Treatment Vertebral the Analgesic Aging Rule and Effect of the Treatment of Primary Dysmenorrhea. Chinese Folk Therapy, 31(02): 43–46.

[8] Zhu L, Zhang L, Ge X, 2021, Clinical Observation on the Treatment of Primary Dysmenorrhea with Cold-Dampness Stagnation by Acupoint Application. Journal of Practical Chinese Medicine, 37(09): 1598–1600.

[9] Tang X, Liu X, Wu X, et al., 2025, Clinical Observation on the Treatment of Primary Dysmenorrhea of Cold Coagulation and Blood Stasis Type with Self-Made Dysmenorrhea Patch Acupoint Application. Modern Distance Education of Traditional Chinese Medicine, 23(04): 104–106.

[10] Zhan Q, Zhan X, Leng P, 2025, Premenstrual Moxibustion CV 8 Point and Close Yuan Acupoint Treatment of Primary Dysmenorrhea: Clinical Curative Effect Analysis. Journal of Jiujiang University (Natural Science Edition), 40(4): 67–71.

[11] Wang N, Gu S, Mao Q, et al., 2021, Research Status of Auricular Point Pressing for Primary Dysmenorrhea. Chinese Prescription Drugs, 19(12): 163–165.

[12] Wang X, Liu H, Zhang X, 2021, Clinical Observation on the Treatment of Primary Dysmenorrhea of Cold Coagulation and Blood Stasis Type with Moxibustion Gua Sha Cupping Combined with Wenjing Decoction. Ningxia Medical Journal, 43(02): 179–180.

[13] Zhang M, 2023, Embedded Wire with Traditional Chinese Medicine Clinical Observation on Treatment of Primary Dysmenorrhea Hemorheological Nature Blood Stasis Syndrome. Journal of Health, Wisdom, 9(10): 221–224.

[14] Feng Y, Feng Y, Zheng C, 2024, Clinical Observation on the Treatment of Primary Dysmenorrhea with Moxibustion of Sanyinjiao Combined with Transcutaneous Electrical Nerve Stimulation. Modern Distance Education of Traditional Chinese Medicine, 22(24): 124–126.

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The Analysis of the Characteristics of 182 Transfusion Reactions Cases and the Effect of Preventive Medication

Ping Hu[1,2], Minghui Chen[1,2], Peng Wei[1,2]*

[1]Department of Blood Transfusion, The Sixth Affiliated Hospital, Sun Yat-sen University, Guangzhou 510000, Guangdong, China
[2]Biomedical Innovation Center, The Sixth Affiliated Hospital, Sun Yat-sen University, Guangzhou 510000, Guangdong, China

***Corresponding author**: *Peng Wei, weipeng3@mail.sysu.edu.cn*

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Abstract: *Objective*: To analyze the characteristics of 182 cases of transfusion reactions and explore the effect of preventive medication. *Methods*: A retrospective analysis was conducted on 182 cases of transfusion reactions reported at the Sixth Affiliated Hospital, Sun Yat-sen University, from February 2022 to January 2025. Non-transfusion reaction cases were selected by random sampling as the control group, and the characteristics and high-risk factors of transfusion reactions were analyzed based on their basic clinical features and medical history data. *Results*: The incidence of platelet transfusion reactions was higher than that of red blood cells and plasma transfusions. The incidence of transfusion reactions and the febrile non-hemolytic transfusion reaction (FNHTR) ratio in women was higher than that in men. The incidence of transfusion reactions and FNHTR ratio in patients with a history of pregnancy was higher than in those without. The incidence of transfusion reactions and FNHTR ratio in patients with a history of prophylactic drug was significantly higher than those without. The FNHTR ratio in type A and O blood recipients was higher than that in type B blood recipients. The FNHTR ratio of red blood cell transfusion was higher than that of plasma and platelet transfusion. The above differences were statistically significant ($p < 0.05$). There was no statistically significant difference ($p > 0.05$) in the reaction types and incidence of transfusion reactions among the age, transfusion history, transfusion reaction history, and chemotherapy/immunotherapy/targeted drug use history of the recipients. There was also no statistically significant difference ($p > 0.05$) in the preventive effects of dexamethasone, promethazine, chlorpheniramine, loratadine, and diphenhydramine on transfusion reactions. *Conclusion*: Women's and pregnancy history are important influencing factors for the occurrence and type of transfusion reactions. The blood type of the recipient and the composition of the transfusion blood can affect the type of transfusion reactions. The effectiveness of prophylactic medication in reducing transfusion reactions is controversial.

Keywords: Transfusion reactions; Febrile non-haemolytic trans-fusion reaction (FNHTR); Allergic reaction; Prophylactic medication

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1. Introduction

Blood transfusion is an indispensable clinical treatment, especially for acute blood loss and hematopoietic disorders. Transfusion reactions are complications occurring during or after transfusion, often hindering treatment, reducing efficacy, and in severe cases threatening life [1,2]. Historically, the incidence of transfusion reactions ranged from 1% to 10% [3]. With advances in testing and blood processing, transfusion-transmitted infections have been somewhat controlled. A study reported a transfusion reaction incidence of 2‰ in China during 2019–2020 [4]. However, non-infectious transfusion reactions, which are largely influenced by recipient factors, remain difficult to prevent. Allergic reactions and febrile non-hemolytic transfusion reactions (FNHTR) account for 97.55% of all transfusion reactions [4]. Currently, prophylactic use of glucocorticoids and antihistamines before transfusion is recommended to prevent non-infectious reactions, but whether this approach is effective and which drugs are preferable remain unresolved [2]. This retrospective study analyzed transfusion reaction cases reported in our hospital from February 2022 to January 2025, aiming to identify characteristics and risk factors and to discuss the necessity and choice of prophylactic medication, so as to inform individualized prevention strategies.

2. Subjects and methods

2.1. Study subjects

2.1.1. Experimental group

Clinical data of 182 reported transfusion reaction episodes at The Sixth Affiliated Hospital, Sun Yat-sen University, from February 2022 to January 2025 were collected.

Inclusion criteria: (1) met diagnostic criteria for transfusion reactions; (2) had complete clinical data.

Diagnostic criteria for transfusion reactions [4,5]: (1) Febrile non-hemolytic transfusion reaction (FNHTR): an increase in body temperature of ≥ 1 ℃ during or within 1–2 hours after transfusion of whole blood or components, with fever and chills as main manifestations, not explainable by other causes. (2) Allergic reaction: within 4 hours of transfusion, patients developed facial flushing, pruritus, erythema, urticaria, angioedema (frequently on the face, lips, or periorbital region), dyspnea, hypotension, bronchospasm, or laryngeal edema; some may also have fever, chills, nausea, vomiting, diarrhea, or abdominal pain. (3) Other reactions: atypical symptoms, but with other causes excluded.

2.1.2. Control group

182 transfusion episodes without any reported reaction were randomly sampled from patients receiving transfusion therapy in the same hospital during the same period, and corresponding clinical data were collected.

2.2. Methods

2.2.1. Data collection

Electronic medical records were reviewed to collect data on age, sex, blood type, blood component transfused, type of transfusion reaction, irregular antibody screening results, history of previous transfusion, history of previous transfusion reactions, pregnancy history, history of bone marrow transplantation, history of chemotherapy/immunotherapy/targeted therapy, and use of prophylactic medication before transfusion.

Total transfusion episodes: 41,207. After excluding 174 episodes with transfusion reactions (8 cases had

both FNHTR and allergic reaction), 182 episodes were included in the experimental group. Using random sampling, 182 non-reaction episodes were selected from the remaining cases as controls, and their data were collected.

2.2.2. Statistical analysis

SPSS 22.0 was used. Continuous data are expressed as mean ± SD; comparisons between groups used *t* tests. Categorical data are described as rates and proportions; comparisons are made using χ^2 or Fisher's exact test. $p < 0.05$ was considered statistically significant.

3. Results

3.1. Baseline characteristics of transfusion reaction cases

From February 2022 to January 2025, 174 transfusion reaction episodes were reported (age range 1–88 years, mean 59.93 ± 17.21 years). The largest age group was 60–69 years (28.18%), followed by 50–59 years (22.42%), then 40–49, 70–79, 30–39, 18–29, ≥ 80, and ≤ 17 years. There were 90 cases of isolated FNHTR, 68 of isolated allergic reaction, and 8 cases with both FNHTR and allergic reaction. All were acute, mild reactions that resolved after symptomatic treatment; no severe adverse events occurred. Only one case had a positive antibody screening test.

3.2. Factors influencing the composition of FNHTR and allergic reactions

The proportion of FNHTR was higher in female recipients than in males ($p < 0.05$). FNHTR proportion was higher for red blood cell transfusion than for plasma, while allergic reaction proportion was higher for plasma than for red blood cells ($\chi^2 = 47.042$, $p = 0.000 < 0.05$). FNHTR proportion was higher for red blood cells than for platelets, and allergic reaction proportion was higher for platelets than for red blood cells ($\chi^2 = 34.024$, $p = 0.000 < 0.05$). No significant difference was found between plasma and platelets regarding FNHTR and allergic reaction proportions ($\chi^2 = 0.070$, $p = 0.791 > 0.05$). Recipients with a history of pregnancy had a higher FNHTR proportion than those without ($p < 0.05$). Recipients receiving prophylactic medication had a higher FNHTR proportion than those without ($p < 0.05$). Blood type B had a higher proportion of allergic reactions than types A and O, while types A and O had a higher FNHTR proportion than type B ($p < 0.05$). No significant differences in reaction type were observed across age groups, transfusion history, history of previous transfusion reactions, or chemotherapy/immunotherapy/targeted drug use ($p > 0.05$). (see **Table 1**)

Table 1. The analysis of the proportion of 182 patients with transfusion reactions (n, %)

Category	Subcategory	FNHTR n(%)	Allergic reaction n(%)	χ^2	*p*
Sex	Male	29 (40.85)	42 (59.15)	12.601	0.000 (< 0.05)
	Female	69 (66.99)	34 (33.01)		
Age	< 60 years	48 (50.53)	47 (49.47)	2.857	0.091 (> 0.05)
	≥ 60 years	50 (63.29)	29 (36.71)		
Blood type	Type A	37 (67.27)	18 (32.73)	8.794	0.032 (< 0.05)
	Type B	15 (37.50)	25 (62.50)		
	Type O	35 (58.33)	25 (41.67)		
	Type AB	11 (57.89)	8 (42.11)		

Category	Subcategory	FNHTR n(%)	Allergic reaction n(%)	χ^2	*p*
Blood component	Red blood cells	76 (83.52)	15 (16.48)	55.388	0.000 (< 0.05)
	Plasma	13 (25.49)	38 (74.51)		
	Platelets	9 (28.13)	23 (71.87)		
Transfusion history	Yes	66 (57.39)	49 (42.61)	0.063	0.801 (> 0.05)
	No	31 (55.36)	25 (44.64)		
History of transfusion reaction	Yes	33 (55.93)	26 (44.07)	0.007	0.934 (> 0.05)
	No	60 (56.60)	46 (43.40)		
Pregnancy history	Yes	63 (67.74)	30 (32.26)	11.834	0.001 (< 0.05)
	No	35 (43.21)	46 (56.79)		
History of chemotherapy/ immunotherapy/targeted therapy	Yes	28 (53.85)	24 (46.15)	0.038	0.845 (> 0.05)
	No	70 (57.38)	52 (46.62)		
Prophylactic medication	Yes	75 (70.09)	32 (29.91)	22.627	0.000 (< 0.05)
	No	23 (34.33)	44 (65.67)		

3.3. Incidence of transfusion reactions by blood component

A total of 41,207 transfusions were administered: 14,808 red blood cell units, 20,516 plasma units, 3,427 platelet units, and 2,456 cryoprecipitate units. The overall transfusion reaction incidence was 4.223‰. Platelets had the highest incidence (9.629‰), followed by red blood cells (6.483‰) and plasma (2.583‰). No reactions occurred with cryoprecipitate. The incidence for platelets was significantly higher than for red blood cells and for plasma ($\chi^2 = 47.547$, $p = 0.000 < 0.05$). (see **Table 2**)

Table 2. The occurrence of transfusion reactions with different blood components

Blood component	Number of FNHTR (N)	Number of allergic reactions (N)	Number of other reactions (N)	Total number of transfusion reactions (N)	Total units transfused (N)	Incidence (‰)
Red blood cells	76	15	5	96	14808	6.483
Plasma	13	38	2	53	20516	2.583
Platelets	9	23	1	33	3427	9.629
Cryoprecipitate	0	0	0	0	2456	0
Total	98	76	8	174 (8 with fever + allergy)	41207	4.223

3.4. Analysis of factors associated with transfusion reactions

The incidence of transfusion reactions was significantly higher in females than in males ($p < 0.05$). The incidence was higher for red blood cells than for plasma ($\chi^2 = 14.570$, $p = 0.000 < 0.05$), and higher for platelets than for plasma ($\chi^2 = 15.403$, $p = 0.000 < 0.05$). No significant difference was found between red blood cells and platelets ($\chi^2 = 1.850$, $p = 0.174 > 0.05$). Recipients with a history of pregnancy had a significantly higher incidence than those without ($p < 0.05$). Prophylactic medication users had a significantly higher incidence than non-users ($p < 0.05$). No significant differences in incidence were found by age, blood type, transfusion history, history of previous transfusion reactions, or history of chemotherapy/targeted/ immunotherapy ($p > 0.05$). (see **Table 3**) No significant differences were observed among the preventive

effects of dexamethasone, promethazine, chlorpheniramine, and others (loratadine, diphenhydramine) (χ^2 = 2.718, p = 0.437 > 0.05).

Table 3. The analysis of influencing factors related to transfusion reactions

Factor		Case group n (%)	Control group n (%)	χ^2	p
Sex	Male	77 (42.31)	113 (62.09)	14.269	0.000 < 0.05
	Female	105 (57.69)	69 (37.91)		
Age	≤ 17 years	6 (3.30)	7 (3.85)	0.105	0.949 > 0.05
	18–59 years	93 (51.10)	91 (50.00)		
	≥ 60 years	83 (45.60)	84(46.15)		
Blood type	Type A	58 (31.87)	39 (21.43)	5.517	0.138 > 0.05
	Type B	40 (21.98)	49 (26.92)		
	Type O	65 (35.71)	76 (41.76)		
	Type AB	19 (10.44)	18 (9.89)		
Blood component	Red blood cells	96 (52.75)	66 (36.27)	35.363	0.000 < 0.05
	Plasma	53 (29.12)	89 (48.90)		
	Platelets	33 (18.13)	14 (7.69)		
	Cryoprecipitate	0 (0.00)	13 (7.14)		
Transfusion history	Yes	117 (64.28)	130 (71.43)	2.737	0.098 > 0.05
	No	62 (34.07)	47 (25.82)		
History of transfusion reaction	Yes	60 (32.97)	50 (27.47)	1.336	0.513 > 0.05
	No	112 (61.54)	122 (67.03)		
	Unknown	10 (5.49)	10 (5.50)		
Pregnancy history	Yes	95 (52.20)	60 (32.97)	12.279	0.000 < 0.05
	No	87 (47.80)	122 (67.03)		
History of chemotherapy/ immunotherapy/ targeted therapy	Yes	55 (30.22)	39 (21.43)	3.672	0.055 > 0.05
	No	127 (69.78)	143 (78.57)		
Prophylactic medication	Yes	112 (61.54)	50 (27.17)	42.758	0.000 < 0.05
	No	70 (38.46)	132 (71.73)		

4. Discussion

Transfusion reactions are classified by timing into acute and delayed. Delayed reactions are often subtle and may be masked by the underlying disease. In this study, the reported incidence of transfusion reactions was 4.223‰, all acute, predominantly FNHTR (2.378‰) and allergic reactions (1.844‰), consistent with Xia et al., but higher than the 2‰ reported by Huang et al. [4,6]. This difference may be due to the upgraded transfusion information management system implemented in our hospital since January 2022, which assists clinical staff and transfusion department personnel in managing transfusion reactions. Moreover, the transfusion department staff conduct telephone follow-ups with all patients within 24 hours after transfusion to further monitor reporting, management, and outcomes, resulting in high recognition and low underreporting, thus making the data reliable.

Females had a significantly higher proportion of transfusion reactions than males, and patients with a

history of pregnancy had a higher proportion than those without, consistent with Wu et al. [7]. Additionally, females and those with a pregnancy history were more prone to FNHTR, whereas males and those without a pregnancy history were relatively more prone to allergic reactions. This is likely because females often have a history of pregnancy, and repeated immune stimulation can produce HLA, HNA, or HPA antibodies, leading to FNHTR [8].

In our study, platelets had the highest reaction incidence (9.629‰), followed by red blood cells (6.483‰) and plasma (2.583‰), with no reactions to cryoprecipitate, similar to Xia et al. [6]. Further analysis showed that red blood cell transfusion was more likely to cause FNHTR than plasma or platelet transfusion, mainly because red blood cell products may contain residual white blood cells that, in antigen-antibody reactions in the recipient, can agglutinate, and after destruction in the mononuclear-phagocyte system, they release endogenous pyrogens, resulting in FNHTR [9]. Current consensus is that a leukocyte content $< 5 \times 10^6$ in blood products can effectively prevent FNHTR [2]. Therefore, improving leukoreduction technology, reducing costs, and expanding the use of leukoreduced products are important for reducing clinical FNHTR. Plasma and platelet transfusions were more likely to cause allergic reactions because they contain abundant plasma proteins that can induce antigen-antibody reactions or directly trigger allergic responses, which are related to both donor and recipient constitution [10]. For patients at high risk of allergy, it is advisable to use products with reduced plasma content.

Domestic guidelines recommend antipyretics (e.g., acetaminophen, aspirin) for preventing FNHTR, and glucocorticoids or antihistamines for preventing allergic reactions [2]. However, the 18th edition of the AABB Technical Manual only recommends acetaminophen for FNHTR prevention and treatment, and does not recommend routine antihistamine prophylaxis for allergic reactions because it may mask early clinical signs of severe reactions such as AHTR, TACO, and TRALI, thereby delaying diagnosis [11]. Studies by Lai and Jiang et al. both indicated that prophylactic use of hormones or antihistamines before transfusion does not reduce the incidence of transfusion reactions [12,13]. In our study, the prophylactic drugs used were glucocorticoids (dexamethasone) and antihistamines (promethazine, chlorpheniramine, loratadine, diphenhydramine). The results showed that recipients pretreated with antiallergic drugs had a significantly higher incidence of transfusion reactions than untreated ones, and no significant difference was found among the different drugs. This may be because clinicians proactively administer prophylaxis to patients at high risk of transfusion reactions, but the efficacy of these drugs is limited, failing to reduce the incidence to the level of the control group. Given that the overall reaction incidence in our hospital was 4.223% and all were mild, with full recovery after symptomatic management and no sequelae, we do not recommend routine prophylactic medication before transfusion, considering patient cost, safety, and limited drug efficacy.

It should be noted that patients with a history of chemotherapy/immunotherapy/targeted therapy had a slightly higher incidence of transfusion reactions than those without, but the difference was not statistically significant ($p = 0.055 > 0.05$). Given the large number of patients receiving antineoplastic agents in our hospital, both the drugs and the patients' immune status may influence the occurrence of transfusion reactions; thus, caution is needed when transfusing such patients. Although the incidence of transfusion reactions increased with age up to the 60–69 year group and then decreased, age itself was not a significant factor. While blood type did not affect overall incidence, type B recipients were more prone to allergic reactions, and types A and O to FNHTR, possibly because ABO antibodies participate in regulating inflammation, infection, and immune responses [14]. No significant differences in incidence were found based

on prior transfusion history or prior reaction history. This may be because the number of prior transfusions was not stratified; generally, two or more prior transfusions have an impact, and the effect increases with the number of transfusions [13–15]. Data on prior transfusion reaction history were mainly obtained from blood requisition forms and rarely from medical records, which may introduce bias. Moreover, the occurrence of transfusion reactions is related to the patient's immune status at a given time. Since a large proportion of our patients have cancer or undergo surgery, a previous transfusion reaction does not guarantee a reaction in subsequent transfusions.

5. Conclusion

In summary, female sex and pregnancy history are important factors influencing both the occurrence and type of transfusion reactions. The recipient's blood type and the blood component transfused may affect the type of reaction. For female, pregnant, type A or type O recipients receiving red blood cells or platelets, leukoreduced products are recommended. Patients with recurrent FNHTR may appropriately use antipyretics for prophylaxis. For male, type B recipients receiving plasma-rich products (plasma, platelets, cryoprecipitate), it is advisable to avoid transfusions during periods of heightened sensitivity and to choose products with reduced plasma protein content. Prophylactic use of glucocorticoids and antihistamines before transfusion is not recommended. The most important measures to reduce transfusion reactions are prevention at the source: rational and appropriate use of blood to avoid unnecessary transfusions, promotion of autologous and component transfusion, and selection of suitable products based on patient condition. Additionally, improving blood processing technologies (e.g., pathogen inactivation, leukoreduction, plasma protein reduction), enhancing component purity, reducing costs, and developing blood substitutes are essential.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Chen H, Wang S, 2015, Effect of Transfusion Reactions on Transfusion Efficacy. Chinese Journal of Blood Transfusion, 28(08): 969–971.

[2] Hu L, 2015, Clinical Transfusion Laboratory Technology. People's Medical Publishing House: 224.

[3] Li Z, Gong J, 2012, Management Procedures for Hemolytic Transfusion Reactions and Bacterial Transfusion Reactions. Chinese Journal of Blood Transfusion, 25(09): 824–825.

[4] Huang Y, Liu Z, 2021, Report on Transfusion Reactions in China. People's Medical Publishing House: 88.

[5] Yang C, Liu J, Zhao T, 2021, Chinese Transfusion Medicine. People's Medical Publishing House: 2792.

[6] Xia Z, Song M, Wang S, et al., 2021, Analysis of Influencing Factors Related to 173 Transfusion Reactions. International Journal of Laboratory Medicine, 42(15): 1866–1869.

[7] Wu L, Luo M, Li H, 2020, Retrospective Analysis of 131 Transfusion Reactions in a Tertiary Hospital. Laboratory Medicine and Clinic, 17(06): 724–727.

[8] Fu W, Zhao X, Shao Q, et al., 2019, Occurrence and Risk Factors of Transfusion Reactions in Obstetrics.

International Journal of Obstetrics and Gynecology, 46(05): 511–514.

[9] Abdallah R, Rai H, Panch S, 2021, Transfusion Reactions and Adverse Events. Clinics in Laboratory Medicine, 41(4): 669–696.

[10] Ikebe E, Matsuoka S, Tanaka A, et al., 2019, Reduction in Adverse Transfusion Reactions With Increased Use of Washed Platelet Concentrates in Japan: A Retrospective Multicenter Study. Transfusion and Apheresis Science, 58(2): 162–168.

[11] Mark K, Fung E, 2014, Noninfectious Complications of Blood Transfusion. In: Technical Manual. 18th ed. Bethesda: American Association of Blood Banks: 677–680.

[12] Lai Z, 2023, Effect of Prophylactic Medication on Reducing the Incidence of Transfusion Reactions. Northern Pharmacy, 20(09): 146–148.

[13] Jiang F, Li Y, Ai H, et al., 2022, Effect of Different Transfusion Frequencies and Prophylactic Medication on the Incidence of Transfusion Reactions. Great Doctor, 7(23): 127–129.

[14] Yang H, Cui Y, 2021, Correlation Between Allergic Diseases and Human ABO Blood Groups. Medical Review, 27(16): 3149–3153 + 3159.

[15] Zhang C, Cao F, Ma J, et al., 2024, Relationship Between Transfusion Frequency and Transfusion Outcome in Patients With Hematologic Diseases Receiving Multiple Transfusions. Clinical Rationale for Drug Use, 17(09): 37–39.

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The Impact of Xinkeshu on Cognitive Function in First-Diagnosed Hypertensive Patients

Jiechun Li[1], Dongxia Jin[2]*

[1]Department of Traditional Chinese Medicine, Tianjin University Hospital, Tianjin 300072, China
[2]Department of Cardiology, Tianjin Chest Hospital, Tianjin 300222, China

***Corresponding author**: Jin Dongxia, jdxkl@126.com

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Abstract: Hypertension is the most prevalent cardiovascular disease, leading to pathophysiological changes in the brain and deterioration of cognitive function by affecting cerebral blood supply and oxygenation. Xinkeshu, a new-generation specific drug for treating coronary heart disease, hypertension, and psycho-cardiological diseases in modern medical research, exhibits antioxidant, myocardial protective, and left ventricular hypertrophy-improving effects in hypertensive patients. However, its impact on cognitive function in hypertensive patients remains unclear. This study included 100 patients first diagnosed with hypertension and initiating antihypertensive treatment at the hypertension outpatient clinic of Tianjin Chest Hospital. Patients were randomly divided into a monotherapy antihypertensive group and a combined Xinkeshu and antihypertensive treatment group (Xinkeshu 4 tablets tid combined with antihypertensive treatment), with 50 patients in each group, and followed up for 3 months. Cognitive function was assessed using the Montreal Cognitive Assessment (MoCA) scale, Logical Memory Test (LMT), and Auditory Verbal Learning Test (AVLT) on the day of enrollment and after 3 months of treatment. *Results:* After 3 months of antihypertensive treatment, all patients showed significant improvement in immediate recall and recognition tests. The combined treatment group demonstrated more significant improvements in MoCA scores, LMT-immediate recall, AVLT-immediate recall, and AVLT-short delay recall scores after 3 months of treatment, while improvements in LMT-delayed recall and AVLT-long delay recall were not significant. This suggests that antihypertensive treatment and combined treatment for 3 months can improve cognitive function by enhancing immediate recall in hypertensive patients. *Discussion:* Xinkeshu may improve cerebral blood supply and oxygenation through the combined effects of its five individual herbs and their separate pharmacological components, thereby improving cognitive function in hypertensive patients.

Keywords: Xinkeshu; Hypertension; Cognition; Memory

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1. Introduction

Hypertension, currently the most common cardiovascular disease, induces certain cerebral pathophysiological changes, such as vascular remodeling, impaired cerebral autoregulation, small lacunar infarcts, white

matter lesions, microbleeds, and amyloid angiopathy, leading to various central nervous system-related complications, such as stroke and vascular dementia, and deterioration of cognitive function. Xinkeshu is a cardiovascular disease treatment drug developed in modern pharmacy, a pure natural traditional Chinese medicine compound preparation mainly composed of *Salvia miltiorrhiza*, *Panax notoginseng*, *Pueraria lobata*, *Aucklandia lappa*, and *Crataegus pinnatifida*. It is clinically used for the intervention of coronary heart disease, hypertension, and psychocardiological diseases. This drug significantly reduces gastrointestinal adverse reactions while retaining efficacy, has clear antioxidant activity, and protects the myocardium and improves left ventricular hypertrophy in hypertensive patients [1,2]. However, its impact on cognitive function in hypertensive patients remains unclear. Therefore, this study included first-diagnosed hypertensive patients, divided them into a conventional antihypertensive treatment group and a conventional antihypertensive combined with Xinkeshu group, and followed them up for 3 months to evaluate the impact of Xinkeshu on cognitive function in hypertensive patients.

2. Subjects and methods

2.1. Subjects

A total of 100 patients first diagnosed with hypertension and initiating antihypertensive treatment at the hypertension outpatient clinic of Tianjin Chest Hospital from August 2023 to December 2023 were selected. They were randomly divided into a combined treatment group (Xinkeshu 4 tablets tid combined with antihypertensive treatment) and a monotherapy antihypertensive group in a 1:1 ratio using a random number table, with 50 patients in each group. The study was approved by the Ethics Committee of Tianjin Chest Hospital (approval number 2025YS-049-01). This study was sponsored by Tianjin Health Project " Multimodal Early Warning and Clinical Prediction Research of Coronary Heart Disease Based on Pericoronary Adipose Tissue (Grant No.TJWJ2025MS035)".

2.2. Diagnostic criteria

(1) Blood pressure measurement

Strictly follow the standardized measurement specifications issued by the World Health Organization in 1999. Subjects discontinued medications that might interfere with blood pressure before the test and rested quietly in a sitting position for 30 minutes. A mercury sphygmomanometer was used to measure the blood pressure of the right brachial artery, and the mean of three measurements on different days was used as the final blood pressure data.

(2) Hypertension

Hypertension diagnosis refers to the 2013 ESH/ESC hypertension guidelines and the 2024 revised edition of the "Chinese Guidelines for the Prevention and Treatment of Hypertension", with systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg as the diagnostic threshold; for those already receiving antihypertensive treatment, a comprehensive diagnosis is made based on past medical history and ambulatory blood pressure monitoring results.

2.3. Inclusion and exclusion criteria

(1) Inclusion criteria

Patients meeting the diagnostic criteria for hypertension and first diagnosed with hypertension, aged

20–65 years, male and female; native Chinese speakers with basic understanding, reading, writing, and communication abilities, and right-handed.

(2) Exclusion criteria

Non-hypertensive patients (SBP < 140 mmHg and DBP < 90 mmHg), aged < 20 years and > 65 years, patients with known psychological and behavioral disorders or any other central nervous system disorders that might interfere with memory and psychomotor function, patients taking other medications known to affect memory and psychomotor function (sedatives, antipsychotics, antidepressants, antihistamines), and those unable to cooperate with testing and medication administration.

2.4. Drug intervention and grouping

All enrolled patients were prescribed conventional antihypertensive drugs by clinicians according to their condition. Patients in the monotherapy antihypertensive group received conventional antihypertensive drugs; the combined treatment group received oral Xinkeshu tablets (Wohua Pharmaceutical) 4 tablets/time, 3 times/day, in addition to conventional antihypertensive treatment, for 3 months. Conventional antihypertensive drugs mainly include ACEIs, ARBs, β-blockers, CCBs, and diuretics. All patients underwent two cognitive function tests and blood pressure measurements on the day of enrollment and after 3 months of antihypertensive treatment, with the mean taken as the final value. To ensure medication adherence and follow-up success rate, all hypertensive patients underwent outpatient follow-up every two weeks.

2.5. Cognitive function assessment

Cognitive function was assessed in all enrolled patients on the day of enrollment and after 3 months of treatment using the Montreal Cognitive Assessment (MoCA) scale, Logical Memory Test (LMT), and Auditory Verbal Learning Test (AVLT).

The Montreal Cognitive Assessment (MoCA) scale is used to comprehensively assess an individual's overall cognitive function, including 8 cognitive domains: visuospatial and executive function (5 points), naming (3 points), attention (3 points), calculation (3 points), language function (3 points), abstraction (2 points), memory (5 points), and orientation (6 points), with a total score of 30 points. A lower score indicates more significant cognitive impairment, and a score < 26 points can be determined as cognitive dysfunction. To reduce assessment bias due to education level, 1 point is added to the raw score for those with ≤ 12 years of education for correction.

The Logical Memory Test (LMT) is a classic neuropsychological test for assessing verbal logical memory, consisting of two assessment stages: immediate recall and delayed recall. The assessment process involves the examiner reading standardized story paradigm materials, and the subject completing immediate free recall; delayed free recall is conducted after a 30-minute interval. The test sets 20 target memory keywords, and correct recall item scoring is used, with 1 point awarded for each correctly recalled item. A lower total score indicates more severe logical memory impairment.

The Auditory Verbal Learning Test (AVLT) is a standardized neuropsychological assessment tool for assessing auditory verbal memory, mainly consisting of three core modules: immediate recall, delayed recall, and recognition. During the assessment, the subject completes 3 rounds of learning-immediate recall cycles for 12 target words, with 1 point awarded for each correctly recalled word and 0 points for incorrect or unrecalled words, with a total immediate recall score of 36 points. After immediate recall, short-delay

and long-delay free recall are conducted after delays of 5 minutes and 20 minutes, respectively, with a total score of 12 points for each stage. Immediately after long-delay recall, a discrimination recognition test is conducted, presenting 12 target words mixed with 12 distractor words. Correct identification of a target word awards 1 point, while misjudging a distractor word as a target word deducts 1 point, with a total recognition score of 12 points. Scores in each dimension are positively correlated with auditory memory function, and a lower score indicates more obvious memory impairment.

2.6. Statistical analysis

Experimental data were statistically analyzed using SPSS 25.0 software. For measurement data, normally distributed data are expressed as mean ± standard deviation ($\overline{x} \pm s$), and skewed distributed data are described by the median (M). Independent sample *t*-tests are used for intergroup comparisons of normally distributed data; the Mann-Whitney U test is used for intergroup comparisons of non-normally distributed data. Count data are expressed as the number of cases and percentage [n (%)], and intergroup comparisons are conducted using the χ^2 test. A p-value < 0.05 is considered statistically significant.

3. Results

3.1. Comparison of baseline data between the two groups

The antihypertensive-only group consisted of 25 males and 25 females, with an average age of (59.34 ± 12.72) years; the combination therapy group consisted of 27 males and 23 females, with an average age of (59.72 ± 12.65) years, showing no statistically significant difference. Additionally, there were no statistically significant differences between the two groups in terms of education level, smoking history, alcohol consumption history, baseline SBP, baseline DBP, baseline HR, MoCA, LMT-immediate recall, LMT-delayed recall, AVLT-immediate recall, AVLT-short-delay recall, AVLT-recognition scores, etc. ($p > 0.05$). There was no statistically significant difference in the prescription rates of β-blockers, ACEI/ARB, and CCB between the antihypertensive-only group and the combination antihypertensive therapy group ($p > 0.05$). The data between the two groups were comparable (see **Table 1**).

Table 1. Comparison of baseline data between the two groups

Indicator	Simple antihypertensive group (n = 50)	Combined treatment group (n = 50)	t/χ^2 value	p value
Male (n, %)	25 (50.00)	27 (54.00)	0.160	0.689
Age (years)	59.34 ± 12.72	59.72 ± 12.65	0.012	0.913
Education level (years)			3.486	0.323
≤ 6 years (n, %)	2 (4.00)	1 (2.00)		
> 6 and ≤ 9 years (n, %)	9 (18.00)	17 (34.00)		
> 9 and ≤ 12 years (n, %)	23 (46.00)	19 (38.00)		
> 12 years (n, %)	16 (32.00)	13 (26.00)		
Smoking history (n, %)	8 (16.00)	6 (12.00)	0.332	0.564
Alcohol consumption history (n, %)	12 (24.00)	17 (34.00)	0.000	1.000
SBP (mmHg)	162.06 ± 2.958	157.76 ± 2.932	2.523	0.115
DBP (mmHg)	89.90 ± 11.20	92.54 ± 10.44	0.286	0.594
HR (bpm)	78.64 ± 16.470	77.10 ± 14.401	0.002	0.966

MoCA (score)	25.68 ± 2.584	25.88 ± 2.097	3.256	0.074
LMT - Immediate recall (score)	11.57 ± 1.352	11.69 ± 1.657	1.271	0.262
LMT - Delayed recall (score)	10.04 ± 1.768	10.26 ± 1.335	0.702	0.484
AVLT - Immediate recall (score)	26.12 ± 2.84	25.24 ± 3.341	1.625	0.205
AVLT - Short-delay recall (score)	7.44 ± 1.768	7.07 ± 1.279	0.775	0.440
AVLT - Long-delay recall (score)	5.94 ± 0.89	5.58 ± 0.38	0.702	0.484
AVLT - Recognition (score)	6.54 ± 0.37	6.28 ± 0.40	0.691	0.562
Prescribed antihypertensive medications				
β-blocker (n, %)	38 (76.00)	30 (60.00)	2.941	0.086
ACEI/ARB (n, %)	23 (46.00)	27 (54.00)	0.640	0.424
CCB (n, %)	15 (30.00)	10 (20.00)	0.832	0.362

Note: A *p*-value less than 0.05 indicates a statistically significant difference.

3.2. Comparison of blood pressure reduction effects between the two groups after 3 months of treatment

After 3 months of treatment, the systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) of patients in the antihypertensive-only group were significantly lower than those at enrollment ($p < 0.001$). However, there was no statistically significant difference in the magnitude of blood pressure reduction between the two groups ($p > 0.05$). (See **Table 2**)

Table 2. Comparison of blood pressure between the two groups after 3 months of treatment

Indicator	Antihypertensive alone group (n = 50)	Combination therapy group (n = 50)	t/χ^2 value	*p* value
SBP (mmHg)	127.06 ± 2.958*	122.76 ± 3.021*	2.523	0.115
DBP (mmHg)	77.46 ± 3.131*	72.34 ± 4.796*	3.699	0.067
HR (bpm)	64.92 ± 8.964*	66.86 ± 9.819*	0.494	0.484

Note: *$p < 0.001$ compared with baseline; a statistically significant difference is considered when $p < 0.05$.

3.3. Changes in cognitive abilities after three months of treatment in both groups

After three months of treatment, both groups of patients showed significant improvements in MoCA scores, LMT-immediate recall, AVLT-immediate recall, and AVLT-short-delay recall scores ($p < 0.001$). Compared with the antihypertensive-only group, the combined treatment group exhibited even more significant improvements in MoCA scores, LMT-immediate recall, AVLT-immediate recall, and AVLT-short-delay recall scores after three months of treatment ($p < 0.0001$). However, improvements in LMT-delayed recall and AVLT-long-delay recall scores were not significant in both groups after treatment. This suggests that antihypertensive treatment and combined treatment for three months can improve cognitive function by enhancing immediate recall in hypertensive patients, with the combined treatment of Xinkeshu showing a more pronounced effect on improving immediate recall compared to antihypertensive-only treatment. (**Table 3**)

Table 3. Comparison of cognitive function scores after three months of treatment between the two groups

Indicator	Antihypertensive alone group (n = 50)	Combination therapy group (n = 50)	t/χ^2 value	*p* value
MoCA (score)	27.55 ± 2.811*	29.08 ± 1.643*	1.278	0.042
LMT-immediate recall (score)	12.58 ± 2.02*	14.80 ± 1.35*	3.353	0.001

Indicator	Antihypertensive alone group (n = 50)	Combination therapy group (n = 50)	t/χ^2 value	p value
LMT-delayed recall (score)	10.59 ± 0.914	11.13 ± 0.653	3.471	0.001
AVLT-immediate recall (score)	26.68 ± 1.729*	27.64 ± 1.378*	3.656	0.000
AVLT-short delayed recall (score)	8.67 ± 1.143*	9.94 ± 1.550**	3.389	0.001
AVLT-long delayed recall (score)	7.93 ± 2.241	8.21 ± 3.692	0.702	0.381
AVLT-recognition (score)	7.630 ± 2.241	7.89 ± 1.557	0.681	0.423

Note: $p < 0.001$ compared with baseline, *$p < 0.001$ compared with baseline. A p-value < 0.05 indicates a statistically significant difference.

4. Discussion

In this study, the cognitive function of patients with first-diagnosed hypertension improved after antihypertensive treatment compared to baseline cognitive function, thanks to improvements in immediate recall function. This suggests that hypertension can lead to a decline in cognitive function, and antihypertensive treatment does not worsen cognitive function while lowering blood pressure; instead, it improves cognitive function in hypertensive patients. Moreover, the combined treatment with Xinkeshu demonstrated a more significant improvement in cognitive function in hypertensive patients.

Previous studies have shown that elevated blood pressure is associated with pathophysiological changes in brain tissue and may affect brain structure and function by influencing intracranial blood flow. Lipsitz et al. demonstrated that intracranial blood flow improved after six months of antihypertensive drug therapy [3]. Short-term antihypertensive treatments, such as beta-blockers and ACE inhibitors, have also been associated with improved intracranial blood flow in hypertensive patients. The improvement in cognitive and memory abilities observed in patients after antihypertensive treatment in this study may also be attributed to improved intracranial blood flow.

Xinkeshu tablets are formulated based on the principles of promoting blood circulation to remove blood stasis and regulating Qi to alleviate pain, with a rigorous combination of principal, assistant, adjuvant, and messenger herbs. Danshen (*Salvia miltiorrhiza*) and Sanqi (*Panax notoginseng*) are used in tandem to exert core pharmacological effects such as antiplatelet aggregation, improving microcirculation, and relieving vascular spasms. Muzhang (*Aucklandia lappa*), Shanzha (*Crataegus pinnatifida*), and Gegen (*Pueraria lobata*) assist the principal and assistant herbs, collectively regulating qi circulation, improving blood rheology, regulating blood lipids, protecting vascular endothelium, and promoting tissue blood supply.

The compatibility of herb pairs is a key entry point for elucidating the compatibility rules and pharmacological material basis of compound formulas. The combined effects and molecular mechanisms of core herb pairs in Xinkeshu tablets are as follows:

(1) Danshen-Sanqi herb pair

This compatibility embodies the classic formula concept of “mutual enhancement”. Pharmacological studies have confirmed that co-decoction of these two herbs significantly increases the dissolution rate of tanshinone and salvianolic acid components and enhances the chemical stability of active ingredients. Modern mechanistic studies indicate that this combination has a significant protective effect on vascular endothelial cell injury induced by hypoxia-reoxygenation, with mechanisms closely related to improving cellular energy metabolism, inhibiting lipid peroxidation reactions, and stabilizing cell membrane structure [4].

(2) Sanqi-Gegen herb pair

Experimental studies by Jin Wen et al. have revealed that a 6:4 ratio of Pueraria lobata flavonoids to *Panax notoginseng* saponins exhibits significant synergistic effects. This combination significantly improves the hypoxia tolerance of cerebral ischemia model animals, with mechanisms involving protecting mitochondrial membrane structure integrity, inhibiting excessive production of oxygen free radicals, thereby delaying the decline in superoxide dismutase (SOD) activity, and exerting a protective effect on damaged brain tissue [5].

(3) Danshen-Gegen herb pair

The combination of these two herbs demonstrates good clinical translational value in the treatment of cerebrovascular diseases. Pharmacological and clinical studies have shown that the combined use of puerarin and Danshen extract can effectively improve vertebrobasilar artery insufficiency and significantly reduce neurological deficit scores in patients with acute cerebral infarction [6,7]. In-depth mechanistic studies indicate that this compatibility can bidirectionally regulate vascular tone, upregulate plasma tissue-type plasminogen activator and nitric oxide levels while inhibiting the release of tissue-type plasminogen inhibitor and endothelin, thereby comprehensively improving vascular endothelial barrier function [8].

(4) Shanzha-Danshen herb pair

In hyperlipidemia pathological models, this herb pair exhibits excellent synergistic effects in regulating blood lipids and antioxidation. Experiments have shown that the combined use of these two herbs significantly reduces plasma total cholesterol, triglyceride, and low-density lipoprotein cholesterol levels, increases high-density lipoprotein cholesterol, and effectively counteracts the decline in SOD activity, suggesting significant pharmacological implications for improving blood rheology, anti-atherosclerosis, and reducing oxidative stress injury [9].

Regarding monomer components:

(1) Sanqi

The core active ingredient of Sanqi is *Panax notoginseng* saponins (PNS), which play prominent roles in cardiovascular and cerebrovascular regulation and brain nerve protection. In preventing and treating cardiovascular and cerebrovascular diseases, PNS can promote blood circulation to remove blood stasis and unblock meridians, reduce blood viscosity, inhibit platelet aggregation, dilate blood vessels, regulate blood lipids, protect vascular endothelium, and improve microcirculation disorders in the body. In brain nerve protection, PNS can promote protein synthesis in the brain, inhibit secondary brain injury, upregulate the expression of neurotrophic factors, exert anti-inflammatory effects, improve cerebral microcirculation, alleviate ischemia and hypoxia, block neuronal apoptosis, and improve memory [10].

(2) Danshen

The main monomer components are tanshinone IIA and salvianolic acid B, which cover multiple targets in the core pathological links of cerebral ischemia. Tanshinone IIA is the core lipid-soluble component of Danshen, covering multiple targets in the core pathological links of cerebral ischemia. It reduces the production of mitochondrial lipid peroxides by regulating the expression of Bcl-2 family apoptosis proteins, blocks abnormal apoptosis of brain cells induced by ischemia and hypoxia; inhibits the activity of sympathetic ganglion cells, reduces catecholamine release, dilates blood vessels, relieves spasms, and improves cerebral microcirculation; enhances SOD activity, scavenges oxygen free radicals, reduces ischemic brain injury; inhibits blood coagulation function and platelet aggregation, blocks calcium overload in brain

tissue cells, reduces cerebral edema, and prevents ischemia-reperfusion injury [11]. Salvianolic acid B is the most abundant water-soluble active ingredient in Danshen, focusing on exerting brain-protective effects by regulating endothelial function and improving energy metabolism. Salvianolic acid B can balance the levels of NO and ET in the body, correct vascular tone disorders, upregulate the expression of VEGF and its receptors, repair damaged microvessels, and optimize cerebral perfusion; simultaneously, it can enhance Na^+-K^+-ATPase activity, maintain ion balance in brain cells, correct energy metabolism disorders, and alleviate ischemic and reperfusion edema injury [12].

(3) Gegen

The effective monomer substance of Gegen is puerarin, which covers multiple molecular pathways and targets neuroprotection. It can upregulate the expression of vascular endothelial growth factor (VEGF) to improve microcirculation in ischemic areas, inhibit intracellular Ca^{2+} overload and optimize cerebral blood supply, balance the expression of the Bcl-2 apoptosis protein family to block neuronal apoptosis, and simultaneously counteract the toxicity of excitatory amino acids, upregulate the expression of NR2a and NR2b subunits in the hippocampal CA1 region, and improve memory ability in neonatal rats with hypoxia-ischemia [13].

(4) Shanzha

Quercetin and hyperoside in Shanzha are the main active ingredients for brain protection, which reduce secondary neural injury after cerebral ischemia through synergistic antioxidant and anti-inflammatory effects. Hyperoside can inhibit the abnormal release of nitric oxide (NO), enhance SOD activity, reduce oxygen free radical production, activate microglia, alleviate local inflammatory reactions, and brain tissue edema [14]. Quercetin can enhance the activity of endogenous antioxidant enzymes, scavenge oxygen free radicals, participate in oxidative stress reactions, and reduce the infarct area of cerebral ischemia [15].

(5) Muzhang

The brain-protective effects of Muzhang mainly originate from costunolide and volatile oils, which can dilate cerebral blood vessels and regulate cerebral blood flow. Pharmacological experiments have shown that Muzhang decostunolide volatile oil can increase cerebral blood flow by 14%, and total costunolide components can increase it by 35%. Both types of components exert indirect neuroprotective effects by improving cerebral perfusion and alleviating ischemia and hypoxia [16].

5. Conclusion

In summary, Xinkeshu tablets are reasonably formulated, addressing both symptoms and root causes, with pharmacological characteristics of multiple targets and pathways. Danshen, Sanqi, and Gegen in the formula are used to regulate blood rheology, representing an exquisite compatibility for improving microcirculation blood flow status and optimizing cerebral microcirculation perfusion. The entire formula uses herbs scientifically and rationally, improving lipid metabolism in the body, reducing blood lipids, significantly enhancing the activity of antioxidant enzymes and immune function; increasing cerebral oxygen content, improving cerebral blood circulation, protecting brain cells, and effectively improving intellectual decline and cognitive dysfunction in patients. Therefore, for patients with first-diagnosed hypertension, the combined treatment with Xinkeshu and antihypertensive drugs may improve cognitive function by improving intracranial blood flow and increasing cerebral oxygen content. However, due to the small sample size in this study, further observation with an expanded sample size is needed.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Xie Y, Pan X, 2024, Meta-Analysis of the Efficacy and Safety of Xinkeshu Combined with Conventional Antihypertensive Treatment for Left Ventricular Hypertrophy in Hypertension. Youjiang Medical Journal, 52(2): 158–168.

[2] Zheng J, Wang H, Wang T, 2023, Meta-Analysis of Xinkeshu Tablets in the Treatment of Ventricular Premature Beats in Coronary Heart Disease. Chinese Journal of Integrative Medicine on Cardio-Cerebrovascular Diseases, 21(13): 2450–2454.

[3] Lipsitz L, Gagnon M, Vyas M, et al., 2005, Antihypertensive Therapy Increases Cerebral Blood Flow and Carotid Distensibility in Hypertensive Elderly Subjects. Hypertension, 45: 216–221.

[4] Zeng G, Liu J, Li P, et al., 2006, Protective Effects of Different Ratios of Danshen and Sanqi on Human Umbilical Vein Endothelial Cells Injured by Hypoxia-Reoxygenation. Fine Chemicals, 23(2): 126–129.

[5] Jin W, Sun H, Sun L, et al., 2004, Protective Effects on Nerve Cell Injury Induced by Simulated Ischemia-Reperfusion. Chinese Journal of Pharmacology and Clinical Research, 20(3): 8–10.

[6] Jiang Y, Jiang X, Zhang D, 2006, Clinical Observation of Puerarin Combined with Compound Danshen Injection in the Treatment of Vertebrobasilar Artery Insufficiency. Information on Traditional Chinese Medicine, 2(4): 24–25.

[7] Wang J, 2005, Puerarin Combined with Compound Danshen Injection in the Treatment of Acute Cerebral Infarction. Zhejiang Journal of Integrated Traditional Chinese and Western Medicine, 15(6): 351–352.

[8] Ren J, Luo X, 2006, Research Progress on the Combined Use of Pueraria lobata and Danshen. Journal of Shanxi College of Traditional Chinese Medicine, 7(3): 51–52.

[9] Wang Y, Fan S, Han J, 2006, Experimental Study on the Lipid-Regulating Effects of the Combined Use of Shanzha and Danshen. Journal of Zhejiang Chinese Medical University, 30(5): 467–468.

[10] Zhu L, Zhang W, Fan J, et al., 2004, Effects of *Panax notoginseng* Saponins on Apoptosis of Hippocampal Nerve Cells in Rats. Chinese Journal of Clinical Rehabilitation, 8(25): 5466–5467.

[11] Hu X, Zhou M, Hu X, et al., 2006, Protective Effects of Tanshinone on Brain Injury and Its Impact on Energy Metabolism in Rats with Cerebral Ischemia-Reperfusion. Chinese Journal of Clinical Pharmacy, 15(3): 176–179.

[12] Jiang Y, Wang Q, Liu Z, et al., 2007, Effects of Salvianolic Acid B on Cerebral Energy Metabolism and Cerebral Edema in Ischemic Mice. Chinese Journal of Pathophysiology, 23(12): 2300–2303.

[13] Ai Z, Yan Z, Wang J, 2010, Effects of Puerarin on the Expression of Bcl-2 and Bax Proteins in the Hippocampal CA1 Region of Rats with Chronic Cerebral Ischemia. Jiangxi Journal of Traditional Chinese Medicine, 41(336): 67–69.

[14] Zhou X, Chen Z, 2010, Protective Effects and Mechanisms of Hyperoside on Hypoxic-Reoxygenation Injury in Neonatal Rat Neurons. Chinese Pharmacological Bulletin, 26(1): 83–86.

[15] Fu Q, Qi Z, Yang R, 2008, Effects of Quercetin-3-Galactoside on Inflammatory Injury Mechanisms in Focal Cerebral Ischemia/Reperfusion in Rats. Chinese Journal of Practical Nervous Diseases, 11(10): 55–57.

[16] Chen D, Yi F, Deng C, 1996, Preliminary Screening Study on the Effects of Spleen-Strengthening and Digestion-Promoting Traditional Chinese Medicines on Digestive Tract Function. Journal of Hunan University of Traditional Chinese Medicine, 16(2): 41.

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Based on the Theory of "Spleen Governing Time", the Clinical Treatment Guidelines for Menstrual Diarrhea are Explored

Ziyi Yang[1], Yingfang Fan[1], Xin Yang[1], Xiaohui Qu[2]*

[1]Shaanxi University of Chinese Medicine, Xianyang 712000, Shaanxi, China
[2]The Second Affiliated Hospital of Shaanxi University of Chinese Medicine, Xianyang 712000, Shaanxi, China

Author to whom correspondence should be addressed.

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Abstract: Menstrual diarrhea is a common periodic gynecological disorder characterized mainly by loose stools and increased frequency during or before and after menstruation, which seriously affects the physical and mental health of women. "Spleen governs time" comes from "Yellow Emperor's Inner Canon", presenting the core ideas of "spleen governs long summer" and "spleen does not govern time", emphasizing the physiological characteristics and pathological tendencies of the spleen in specific seasons. Based on the connotation of the theory of "spleen governing time", and in combination with the pathogenesis characteristics of menstrual diarrhea, which is characterized by "spleen deficiency as the root, excessive dampness as the symptom, and aggravation during menstruation", this paper explores the clinical treatment principles and the application of prescriptions based on this theory, providing new ideas and theoretical basis for the traditional Chinese medicine treatment of menstrual diarrhea.

Keywords: Spleen governs the season; Menstrual diarrhea; Clinical treatment; Spleen deficiency with excessive dampness

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1. Introduction

The theory of "spleen governs time" originated from "Yellow Emperor's Inner Canon", based on the holistic concept of traditional Chinese medicine, matching the Zangfu organs with the seasons and the five elements, and proposing two core ideas: "Spleen governs long summer" and "spleen does not govern time" [1]. But when modern physicians delve into what the spleen governs, the argument given in "Inner Canon" seems rather contradictory. The reason for this is that the viewpoints are different.

"Shi" refers to the season, a concept that originated from ancient humans' continuous exploration of the dimensions of time and space. The relationship between the five internal organs and the seasons mainly

originated from the ancient Chinese theory of the different affiliations of the five elements and directions and the seasons. It was only after the theory of the four seasons and five Elements was established that the specific affiliations were further explored by later generations.

Traditional Chinese medicine (TCM) adopts a unique five-season division system for the annual cycle, which expands the conventional four-season classification into spring, summer, late summer, autumn, and winter. Each season corresponds to one of the five fundamental elements: wood, fire, earth, metal, and water. As the Zang-organ corresponding to the earth element, the spleen is closely associated with late summer. This specific seasonal period is characterized by sweltering heat and heavy humidity, while the spleen has an inherent physiological preference for dry environments and an aversion to pathogenic dampness. For this reason, damp pathogen invasion frequently impairs the spleen's core transforming and transporting functions during late summer.

Moreover, TCM holds the theoretical viewpoint that "the spleen dominates the concluding phase of all four seasons". Earth Qi prevails at the tail end of spring, summer, autumn, and winter, marking a period of robust splenic activity. In this phase, the spleen is capable of nourishing the heart, liver, lung, and kidney, yet it also becomes vulnerable to functional disorders triggered by unhealthy dietary habits and irregular work-rest routines.

From the perspective of visceral correlation, the seasonal domination characteristic of the spleen is not merely an independent seasonal law of this single organ. Instead, it embodies the spleen's core status as the postnatal foundation of the human body and the origin of Qi and blood production. The spleen digests and absorbs nutritional essences from dietary water and grains, and sustains the physiological functions of other Zang-fu organs via essence distribution. This nourishing effect of the spleen becomes more pronounced during seasonal transition intervals.

Sustained splenic dysfunction will lead to internal accumulation of water-dampness pathogens, which disrupts not only splenic transportation and transformation but also the physiological operation of other visceral organs. For instance, downward pouring of dampness into the large intestine can induce diarrheal symptoms, while dampness stagnation in the Chong and Ren conception vessels may trigger menstrual cycle disorders. This pathological mechanism serves as a key pathological basis for the occurrence of menstrual diarrhea.

2. The pathogenesis of menstrual diarrhea in relation to the theory that the spleen governs time

The core pathogenesis of menstrual diarrhea is spleen deficiency with excessive dampness. During menstruation, Qi and blood descend to the Chong and Ren meridians, exacerbating the symptoms of spleen deficiency. Dampness takes advantage of the deficiency and causes diarrhea to occur. This pathological process is highly consistent with the seasonal characteristics and physiological weaknesses of the spleen in the theory of "spleen governing the season" [2].

2.1. Spleen deficiency is the root cause, and earth does not control water

The spleen governs transformation and is the source of Qi and blood production, and also governs blood. If the spleen and stomach are weak by nature, or if the spleen is damaged due to improper diet, excessive

fatigue, or excessive worry, the spleen fails to function properly, and the essence of food and water cannot be normally transformed and absorbed; water and dampness will remain in the large intestine, resulting in loose stools. During menstruation, Qi and blood descend to the Chong and Ren uteri, and the Qi and blood of the spleen become even weaker. The ability to transform and transport water and dampness is further weakened. Dampness obstructs the intestines, conduction is disrupted, and thus diarrhea occurs. This is consistent with the pathological feature in the theory of "spleen governing time" that when the spleen function is abnormal, water and dampness will be retained internally. Whether in season or not, spleen deficiency is always the root cause of the disease.

2.2. Dampness as the symptom, seasonal induction

Dampness is an important trigger for the onset of diarrhea during menstruation, and its generation is directly related to the seasonal characteristic that "the spleen governs long summer". During the long summer, dampness is dominant. If dampness is contracted at this time, or if there is a preference for raw, cold, greasy, and rich foods in the diet, dampness is generated, dampness restrains the spleen, the spleen Yang is suppressed, the transformation and transportation fail, and water and dampness accumulate internally. When the menstrual period comes, the Qi and blood descend to the Chong and Ren meridians, the Yang Qi of the spleen becomes even weaker, and the dampness cannot be transported and transformed, thereby causing diarrhea. In addition, on the last eighteen days of the four seasons, the earth energy is dominant. If the function of the spleen is out of balance at this time and water and dampness are produced internally, it can also be a potential cause of menstrual diarrhea, reflecting the influence of the theory of "spleen governing the season" on the regularity of disease onset.

2.3. Dysregulation of the Chong and Ren meridians, mutual disturbance of the spleen and dampness

The Chong and Ren meridians are closely related to the spleen and stomach, and the Qi and blood transported and transformed by the spleen and stomach are the material basis for the abundance of the Chong and Ren meridians. When the spleen fails to function properly, Qi and blood are produced insufficiently, and the Chong and Ren meridians are not nourished. At the same time, water and dampness remain inside, dampness blocks the Chong and Ren meridians, and the circulation of Qi and blood is not smooth, aggravating the imbalance of Qi and blood during menstruation. The changes of Qi and blood in the Chong and Ren meridians during menstruation will in turn affect the spleen, further exacerbating the state of spleen deficiency and excessive dampness, forming a pathological cycle of "spleen deficiency–excessive dampness–Chong and Ren dysfunction–diarrhea", which also confirms the overall concept in the theory of "spleen governing the seasons" that the Zang-fu organs and the seasons and meridians interact with each other [3].

3. Clinical treatment guidelines for diarrhea during menstruation based on the theory of "spleen governing the season"

Guided by the theory of "spleen governing time", the treatment of menstrual diarrhea should follow the core principle of strengthening the spleen and removing dampness, combine seasonal characteristics and physiological changes during menstruation, adopt the strategy of "staged treatment and time-division care", take into account both symptomatic and root treatment, and harmonize the function of the spleen and the Qi

and blood of the Chong and Ren meridians.

3.1. Staged treatment: Treat the symptoms during menstruation and the root cause during normal times

The onset of menstrual diarrhea has a distinct periodicity. Treatment should be divided into two stages: menstrual and non-menstrual, and the prescription should be adjusted in accordance with the law of Qi and blood changes of the spleen in the theory of "spleen governs time" [4].

3.1.1. Treat the symptoms during menstruation, strengthen the spleen, remove dampness, and stop diarrhea

During menstruation, Qi and blood descend to the Chong and Ren meridians, and the symptoms of spleen deficiency and excessive dampness are particularly prominent. Treatment should focus on strengthening the spleen to remove dampness and astringing the intestines to stop diarrhea, while also taking into account the regulation of Qi and blood in the Chong and Ren meridians, and avoiding greasy substances that are detrimental to the spleen [5]. The common prescription is the modified version of Shenling Baizhu Powder combined with Tongxie Yao. Shenling Baizhu Powder strengthens the spleen and benefits Qi, absorbs dampness and stops diarrhea, in line with the characteristics of the spleen that prefers dryness and dislikes dampness; The pain-relieving formula soothes the liver and strengthens the spleen, and is suitable for diarrhea caused by spleen deficiency and liver depression, as emotional fluctuations during menstruation can easily lead to liver Qi stagnation, wood overflows earth, aggravating spleen deficiency diarrhea. If there is excessive dampness and loose stools like water, coix seed and plantago seed can be added to promote diuresis and remove dampness. If the spleen is weak, the spirit is weak, shortness of breath and lack of speech, *Astragalus membranaceus* and *Codonopsis pilosula* can be added to enhance the power of tonifying Qi; If there is coldness in the uterus and abdominal pain, mugwort leaves and pickled ginger can be added to warm the middle and dispel cold, taking into account coldness in the Chong and Ren meridians.

3.1.2. Treat the root cause in daily life, tonify the spleen, benefit Qi, and consolidate the root

The non-menstrual period is a crucial time for regulating the function of the spleen. One should follow the idea that the spleen is the foundation of the acquired constitution in the theory of "the spleen governs the time", and use the methods of tonifying the spleen and Qi and nourishing the earth to consolidate the foundation to enhance the transformation and transportation function of the spleen and fundamentally prevent the generation of dampness. The common prescription is the combination of Buzhong Yiqi Decoction and Sijunzi Decoction, modified. The Buzhong Yiqi Decoction raises Yang and ascenders, enhancing the ascending and descending functions of the spleen and stomach Qi movement. The Four Gentlemen Decoction strengthens the spleen and benefits Qi, and is the basic formula for tonifying the spleen. During the long summer, when dampness is dominant, Agastache and Eupatorium can be added to dispel dampness and invigorate the spleen. In the last 18 days of the four seasons, when the earth energy is dominant, it is appropriate to add yams, coix seed, and other neutral foods that nourish the spleen in accordance with the earth energy. At the same time, the prescription can be adjusted according to the patient's constitution. For example, for those with liver depression, add Bupleurum and *Paeonia lactiflora* to soothe the liver and relieve depression; for those with kidney deficiency, add *Psoralea corylifolia* and Yizhiren to warm and tonify the spleen and kidney. Since "the kidney is the foundation of the innate constitution and the spleen is

the foundation of the acquired constitution", tonifying both the spleen and kidney can enhance the therapeutic effect.

3.2. Time-based care: Adapt to the seasons and avoid the triggers

Based on the theory that the spleen governs the season, the care of menstrual diarrhea should adapt to the climatic characteristics of different seasons, avoid the inducements that damage the spleen, and assist drug treatment to improve the therapeutic effect.

3.2.1. Care during the long summer season

In the theory of "the spleen governs the season", the long summer belongs to earth and is governed by dampness, which corresponds most vigorously to the spleen. It is the time of the year when the spleen has the heaviest burden of transforming water and dampness and is most vulnerable to evil. The climate of the long summer is hot and humid, with an abundance of rain and dampness. Dampness is heavy, turbid, and sticky, which is most likely to suppress the Yang of the spleen and impede the movement of Qi. During the menstrual period, Qi and blood descend to the Chong and Ren meridians, and the spleen Qi is already deficient. If the long summer is damp, the external dampness will trigger the internal dampness, the spleen deficiency will be even more severe, and the dampness will be more abundant, which is very likely to induce or aggravate menstrual diarrhea. Therefore, the long summer is a critical period for the prevention of menstrual diarrhea.

Long summer protection should focus on the physiological characteristics of the spleen, which dislikes dampness, prefers dryness, and governs transformation and transportation, with the core being to clear heat and remove dampness, invigorate and strengthen the spleen, and warm and protect the spleen, Yang. In daily life, avoid rain, dew, and dampness, do not sit or lie on wet ground, and reduce exposure to rain and wading through water to prevent external dampness from invading the spleen. The diet should be light, soft, and easy to digest. Avoid raw and cold fruits, cold drinks, and rich and greasy foods to prevent internal dampness. Red adzuki beans, coix seed, poria, agastache, lotus leaves, and other foods that clear summer heat and dampness and invigorate the spleen and harmonize the middle can be used to remove dampness without harming the spleen and clear heat without warming the spleen. If the menstrual period coincides with the long summer and shows symptoms such as sticky stools, burning anus, bitter and sticky mouth, and yellow and greasy coating of damp-heat descending, on the basis of strengthening the spleen, one should combine *Coptis chinensis*, *Phellodendron amurense*, *Portulaca oleracea*, and other heat-clearing and diuretic substances to remove dampness, clear heat, and restore the spleen's function.

3.2.2. End-of-season care

On the eighteenth day of the end of the fourth season, the earth energy is dominant, and the spleen function is relatively vigorous. It is the best time to nourish the spleen. You can add *Codonopsis pilosula*, *Astragalus membranaceus*, red dates, etc., to your diet to make soup or porridge. At the same time, pay attention to the balance of work and rest, avoid overwork that harms the spleen, keep a pleasant mood, and prevent worry from harming the spleen. Late spring: Soothe the liver and regulate the spleen, transform dampness, and harmonize the middle. Be cautious in damp and shady places, eat less rich and greasy food, and regulate emotions to prevent the liver wood from overtaking the spleen. Late summer: Clear heat and dampness,

warm and invigorates the spleen. Avoid excessive cold drinks and prolonged exposure to cold and dampness. The diet should be light and diuretic. Late autumn: When warming and strengthening the spleen, dispelling cold and strengthening the intestines, pay attention to keeping the abdomen warm, reduce raw and cold fruits, and increase foods that strengthen the spleen and strengthen the intestines. Late winter: Warm the middle to strengthen the spleen, boost Yang to strengthen the root, guard against cold invading the spleen, eat more warm and nourishing foods, and avoid overwork that harms the spleen.

3.2.3. Seasonal care and adjustment

Spring energy connects the liver, liver wood easily overcomes spleen earth; Wind pathogen combined with dampness can easily encase the spleen. Care should focus on soothing the liver and strengthening the spleen, warming and transforming dampness: pay attention to keeping the waist and abdomen warm, and avoid raw, cold and cool foods; The diet should include yam, poria, dried tangerine peel, ginger, etc., to soothe the liver, strengthen the spleen and remove dampness; Avoid wading through water in the rain or sitting on wet ground for long periods. Summer is at its peak of heat and dampness, which can easily dampen the spleen, Yang. In addition to the excessive consumption of cold drinks, it further impairs the spleen's function. To clear summer heat, promote diuresis, warm the spleen, and protect Yang: avoid direct air conditioning and excessive consumption of cold drinks and fruits; Use coix seed, red adzuki beans, agastache, winter melon, etc. to clear the heat and invigorate the spleen; The diet should be warm, soft, and easy to digest to reduce the burden on the spleen and stomach. Autumn is cool and dry, which can harm the spleen Yang and deplete the spleen Yin. It is advisable to warm and nourish the spleen, avoid the cold and protect the middle: Add clothes in time to keep the abdomen warm; Eat less cold melons and vegetables and spicy and pungent foods; Use more lotus seeds, coix seeds, pumpkins, yams, etc. to strengthen the spleen and intestines. The cold of winter is most likely to damage the spleen Yang, causing the curd to be weak and water dampness to descend. Focus on warming the middle, strengthening the spleen, dispelling cold, and stopping diarrhea: Keep the waist, abdomen, and soles warm, and apply warm compresses to the navel and abdomen; Eat more lamb, ginger, longan, etc. to warm the middle and boost Yang; Avoid raw, cold, and cool foods and cold pathogen invasion.

3.2.4. Special care during menstruation

Avoid getting cold during menstruation, especially keeping the abdomen warm to prevent cold invasion of the spleen and stomach; Avoid vigorous exercise to prevent depletion of Qi and blood; Eat warm, easily digestible food and avoid raw, cold, spicy, and stimulating foods; Keep your mood stable and avoid liver Qi stagnation invading the spleen earth.

3.3. Add or subtract based on syndrome differentiation: Take into account both syndromes and be flexible

In clinical practice, the prescription should be adjusted in accordance with the specific complications of the patient to reflect the characteristics of syndrome differentiation and treatment in traditional Chinese medicine. If a patient is accompanied by liver depression and Qi stagnation, with symptoms such as breast distension and pain during menstruation, irritability and anger, and diarrhea with mood swings, the pathogenesis is closely related to the fact that spring Qi affects the liver and liver wood overcomes spleen earth. In spring, Yang energy ascends, and liver energy is excessive, which is prone to invade the spleen; Even if it is not

spring, at the end of the four seasons, when the spleen earth is dominant, the Qi movement is blocked and is easily taken over by the liver, causing abnormal spleen movement and diarrhea. At this time, on the basis of strengthening the spleen and eliminating dampness, add substances such as bupleurum, curcuma, and *Cyperi rhizopus* to soothe the liver and regulate Qi, with the aim of soothing the liver to support the spleen and regulating Qi to assist transportation, so that the liver can move forward without taking advantage of the spleen earth, in accordance with the ascending and descending of Qi in the four seasons, and restore the function of the spleen in governing transportation and transformation. If there is also a deficiency of kidney Yang, with symptoms such as diarrhea at five o 'clock in the morning, aversion to cold, cold limbs, soreness and weakness of the waist and knees, it is a deficiency of spleen and kidney Yang, corresponding to the seasonal characteristics of winter Qi that connects the kidneys and fire that does not warm the earth. In winter, cold pathogens are more prevalent and are most likely to damage Yang; Kidney Yang is the root of spleen Yang. If kidney Yang is insufficient, the spleen will lose its warmth, and water dampness will not be able to evaporate and transform. When it descends to the large intestine, diarrhea will not stop. At the end of the four seasons, when the spleen earth is in power, kidney Yang is especially needed to assist in its transformation and transportation. At this time, the Four Gods Pill is intended to warm and tonify the spleen and kidneys, consolidate the intestines and stop diarrhea, so that the kidney Yang is full, the spleen Yang is warm, and the earth gives rise to fire, in line with the "spleen governs the season" principle of strengthening Yang and protecting the spleen Yang in winter and at the end of the season. If it is accompanied by damp-heat descending, with symptoms such as sticky stools, a burning sensation in the anus, and a bitter and sticky mouth, it is often associated with excessive dampness in summer and long summer. In the long summer, dampness is dominant, dampness invades the spleen and turns into heat, and damp-heat descends to the large intestine, causing diarrhea, stickiness, and discomfort. The spleen prefers dryness and dislikes dampness. Excessive dampness causes the spleen to be obstructed, and excessive heat causes the spleen to be damaged. Therefore, on the basis of strengthening the spleen, ingredients such as *Coptis chinensis*, *Phellodendron amurense*, and *Portulaca oleracea* are added to clear heat and promote diuresis, aiming to clear seasonal damp-heat and restore the spleen's transport, so as to eliminate pathogenic factors without harming the spleen and clear heat without attacking Yang, in accordance with the physiological characteristics of the spleen that "dislikes dampness, prefers dryness, and governs the transformation of dampness".

4. Conclusion

The theory of the spleen governing the seasons is an important manifestation of the holistic concept and syndrome differentiation and treatment in traditional Chinese medicine. Its core idea emphasizes the close connection between the function of the spleen and seasonal changes. The pathogenesis of menstrual diarrhea is based on spleen deficiency and excessive dampness, and the changes of Qi and blood in the Chong and Ren meridians during the menstrual period are highly consistent with the physiological characteristics and pathological tendencies of the spleen to prefer dryness and dislike dampness and to transform and transport water and dampness in the theory of "spleen governing the season" [6]. The clinical treatment based on this theory adopts the policy of "staged treatment and time-specific care", strengthening the spleen to remove dampness and stop diarrhea during menstruation to treat the symptoms, tonifying the spleen to benefit Qi and consolidate the root in daily life, and avoiding inducing factors in accordance with seasonal characteristics,

which can effectively regulate the function of the spleen and break the pathological cycle of "spleen deficiency–dampness excess–diarrhea".

In clinical practice, it is necessary to be flexible and adaptable based on the patient's constitution, concurrent syndrome, and seasonal differences, taking into account the mutual influence of the Zang-fu organs, meridians, and seasons, and embodying the holistic idea of "harmony between man and nature" in traditional Chinese medicine. Further research on the clinical efficacy and mechanism of menstrual diarrhea based on the theory of "spleen governing time" can be carried out in the future to provide more evidence-based evidence for the treatment of periodic gynecological diseases with traditional Chinese medicine.

Disclosure statement

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References

[1] Zhang L, Zuo X, 2025, "The Theory of Spleen Governing Time" and the Construction and Clinical Application of the Essence of Spleen Storage in the Huangdi Neijing. Chinese Journal of Ethnic and Folk Medicine, 34(05): 1–4.

[2] Shen F, Liu L, Han Y, 2022, Professor Han Yanhua's Method of Warming the Uterus and Strengthening the Spleen for the Treatment of Diarrhea During Menstruation. Shi Zhen Chinese Medicine, 33(06): 1428–1429.

[3] Dong Y, Sun Y, Wang H, et al., 2018, Discussion on Etiology and Pathogenesis of Menstrual Diarrhea. Jiangxi Journal of Traditional Chinese Medicine, 49(12): 9–11.

[4] Zheng Z, Pan H, Li H, 2018, 3 Cases of Li Hongmei, Chief Physician, in the Treatment of Menstrual Diarrhea. Guangxi Journal of Traditional Chinese Medicine, 41(03): 42–43.

[5] Xu M, 2016, Clinical Study on the Treatment of Diarrhea-Predominant Irritable Bowel Syndrome (Spleen Deficiency Type) Using Box Moxibustion Based on the Theory of "Spleen Governing Time", thesis, Chengdu University of Traditional Chinese Medicine.

[6] Diao Y, Wu K, 2016, Case of the Famous Doctor, a Kind Woman Treated for Spleen Disease. China's Basic Medical Journal of Traditional Chinese Medicine, 22(04): 456–457.

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Research on the Establishment of an Integrated Medical, Nursing, and Care Service System for Elderly Patients with Chronic Diseases in the Shandong Section of the Yellow River Basin

Liqun Zhao, Fan Li, Xiaoqian Yang, Feng Xu, Shun Yuan, Nana Wang*

Qilu Institute of Technology, Jinan 250200, Shandong, China

Author to whom correspondence should be addressed.

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Abstract: Against the dual strategic backdrop of healthy aging and high-quality development in the Yellow River Basin, the Shandong section of the basin exhibits pronounced trends of population aging and high prevalence of chronic diseases among the elderly. Traditional medical, elderly care, and nursing services operate in a fragmented manner, with significant issues such as disconnection between medical care and elderly support, separation of nursing and care services, and imbalanced resource allocation, making it difficult to meet the long-term continuous care needs of elderly patients with chronic conditions. Grounded in the theories of holistic governance and collaborative governance, this study employs literature review, field research, case analysis, and expert consultation to examine the current state, practical challenges, and underlying causes of integrated medical-nursing-care services for elderly patients with chronic diseases in the Shandong section of the Yellow River Basin. It proposes establishing a comprehensive service framework encompassing four dimensions, service providers, service content, service processes, and service support; develops differentiated implementation pathways for urban and rural areas, and establishes a sustainable mechanism integrating policy, talent, funding, and regulatory oversight. This research provides theoretical insights and practical models for enhancing health service delivery for elderly patients with chronic diseases in the Yellow River region, promoting deep integration of medical, nursing, and care services, and advancing the realization of healthy aging.

Keywords: Shandong section of the Yellow River Basin; Chronic diseases in the elderly; Integrated medical-care-protection system; Service framework; Collaborative governance

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1. Introduction

Population aging and the high prevalence of chronic diseases have become critical issues in China's social development. The incidence of chronic diseases among individuals aged 60 and above remains persistently

high. Chronic diseases are characterized by prolonged duration, susceptibility to recurrence, and require long-term care, making reliance solely on medical institutions or home-based care insufficient to meet diverse health and wellness needs. Both the "Healthy China 2030" Planning Outline and the Yellow River Basin Ecological Protection and High-Quality Development Planning Outline explicitly call for improving the elderly health service system and promoting deep integration between medical and elderly care services [1]. The Shandong section of the Yellow River basin encompasses nine cities along the river, including Jinan, Zibo, Jining, and Heze, exhibiting a pronounced urban-rural dichotomy with uneven spatial distribution of medical and elderly care resources, particularly highlighting challenges in rural aging and chronic disease management. While domestic research has extensively explored integrated medical and elderly care services as well as chronic disease management for the elderly, most studies focus on individual cities or specific service dimensions, with limited comprehensive and specialized research on integrated medical, nursing, and care services for chronic diseases across the Shandong region. Existing studies suffer from gaps between theory and grassroots practice, inadequate regional adaptability, and poor implementability [2]. Additionally, technologies such as smart monitoring and big data have not been fully integrated into the medical-nursing-care service system, and age-friendly health and wellness services at the grassroots level remain insufficient [3]. Based on these findings, this study aims to develop an integrated medical-nursing-care service system tailored to the Shandong section of the Yellow River basin, addressing service fragmentation and enhancing the grassroots elderly health service network.

2. Core concepts and theoretical foundations

2.1. Definition of core concepts

2.1.1. The Shandong section of the Yellow River Basin

It specifically refers to the entire territories of the nine prefecture-level cities along the Yellow River in Shandong Province, encompassing urban communities, rural towns and villages, primary healthcare institutions, and various elderly care facilities. This region represents a typical area in the lower reaches of the Yellow River, characterized by high aging rates and concentrated demand for health and wellness services.

2.1.2. Chronic diseases in the elderly

These are chronic diseases characterized by high prevalence and requiring long-term management in individuals aged 60 years and above, primarily including hypertension, diabetes mellitus, coronary heart disease, and post-stroke sequelae, with features such as high incidence rates, significant complications, and substantial dependence on long-term care.

2.1.3. Integrated medical care, nursing, and elderly care services

Guided by the needs of elderly patients with chronic diseases, this initiative breaks down barriers between healthcare, elderly care, and nursing sectors by integrating resources encompassing diagnosis and treatment, rehabilitation care, daily living support, health education, and psychological counseling. It establishes a novel comprehensive wellness service model characterized by integrated service chains, multi-stakeholder collaboration, and closed-loop service processes.

2.2. Theoretical basis

2.2.1. The theory of holistic governance

Centered on public needs, this approach emphasizes the integration and coordinated collaboration of resources across departments and industries to address governance challenges such as fragmented public services, divided responsibilities, and information barriers. The chronic disease care services for elderly individuals in the Shandong section of the Yellow River Basin involve multiple departments, including health authorities, civil affairs agencies, and medical insurance institutions, as well as various service providers. Applying this theoretical framework provides a governance rationale for coordinating resources, clarifying responsibilities, and eliminating service gaps [4].

2.2.2. Collaborative governance theory

Emphasis should be placed on the equal participation, division of responsibilities, collaboration, and information sharing among diverse stakeholders, including governments, medical institutions, elderly care facilities, communities, and families, to foster a synergistic governance framework. The integration of healthcare, medical services, and elderly care cannot be achieved by a single entity alone; leveraging the theory of collaborative governance enables the establishment of an operational mechanism with clearly defined authorities and responsibilities, ensuring smooth coordination and preventing fragmented approaches or buck-passing.

2.2.3. Long-term care theory

Focusing on the continuous care needs of elderly individuals with disabilities, partial disabilities, or chronic diseases, this approach encompasses multidimensional aspects including medical care, daily living assistance, and emotional support, providing theoretical foundations for the design of integrated healthcare, nursing, and elderly care services as well as the establishment of comprehensive lifelong care workflows.

3. Current status and challenges of medical care services for elderly patients with chronic diseases in the Shandong section of the Yellow River Basin

3.1. Current development status

3.1.1. The care needs of elderly patients with chronic diseases exhibit differentiated characteristics

The prevalence of chronic diseases among the elderly in the Yellow River region remains persistently high, with the proportion of empty-nest and solitary elderly individuals increasing annually. Urban seniors primarily require rehabilitation care and psychological services, whereas rural elderly residents have a pressing need for basic medical diagnosis, daily care, as well as home-based nursing services, remote monitoring, and emergency assistance [5].

3.1.2. Structural shortcomings in the provision of medical, nursing, and care services are prominent

The chronic disease diagnosis and treatment system in municipal and county-level medical institutions is relatively well-established, but primary community health service centers and township clinics lack adequate rehabilitation and nursing capabilities. Public elderly care institutions face bed shortages, while private

institutions often provide insufficient medical support, offering only basic daily care services. There is a significant shortage of specialized nursing personnel, with low professional competence among grassroots practitioners, and inadequate coverage of standardized chronic disease care.

3.1.3. There is sufficient policy guidance, but insufficient detailed implementation measures

Shandong Province has formulated relevant plans for elderly care services and integrated medical-care services, yet lacks specialized supporting policies tailored for the Yellow River region. There is poor policy coordination among departments, insufficient data interoperability, and integration of medical, nursing, and care services remains superficial rather than achieving a deeply integrated operational framework.

3.2. Main existing issues

3.2.1. Service fragmentation and gaps in supply-demand alignment

The medical, elderly care, and nursing sectors operate independently: healthcare institutions prioritize acute-phase diagnosis and treatment while neglecting continuous rehabilitation; elderly care facilities provide care services but lack medical services; nursing services are concentrated in urban high-end markets with inadequate coverage at the grassroots level [6]. There is a lack of seamless transition mechanisms for post-discharge rehabilitation and home-based care for chronic disease patients, leading to a dual disconnect between medical care and elderly care, as well as between nursing services and elderly care.

3.2.2. Imbalanced resource allocation leads to significant urban-rural disparities

Central cities concentrate healthcare and wellness resources, whereas county-level and rural areas suffer from outdated facilities, talent shortages, limited-service offerings, and a lack of mechanisms for resource allocation at the grassroots level or targeted assistance. The accessibility of public wellness services remains inadequate, failing to meet the basic care needs of elderly individuals with chronic diseases in rural areas.

3.2.3. Ambiguous rights and responsibilities among multiple stakeholders lead to low collaborative efficiency

The healthcare and elderly care system involves multiple stakeholders, yet it lacks a clear delineation of responsibilities and collaborative frameworks. Government oversight and coordination at the highest level remain inadequate, institutional participation is insufficient, community hubs fail to fulfill their pivotal role effectively, and there is a lack of a sustained collaborative platform, leading to issues such as overlapping jurisdictions and weak coordination.

3.2.4. Shortage of professional talent and insufficient service specialization

The primary healthcare and wellness industry suffers from low salaries, limited career development opportunities, and severe talent loss in professional nursing and chronic disease management. Most current practitioners lack systematic training and possess insufficient professional competence. Furthermore, there is a disconnect between university education programs and grassroots needs, with inadequate mechanisms for targeted talent cultivation and practical training.

3.2.5. The safeguard mechanisms are inadequate, resulting in weak long-term sustainability

The absence of regional industry standards and regulatory guidelines results in funding reliance on fiscal

allocations with low participation from private capital; no unified service quality evaluation and dynamic supervision system has been established, leading to inconsistent service quality and hindering the long-term scaling up of pilot services.

3.3. Causes of the problem

The top-level design lacks consideration for regional differences, making general policies difficult to accommodate the disparities in urban and rural development along the Yellow River; healthcare, elderly care, and nursing services are administered by separate authorities, creating persistent industry barriers; the limited variety of funding models results in restricted profit potential for public welfare wellness initiatives and weak incentives for private capital participation; inadequate mechanisms for talent compensation and career advancement systems diminish industry appeal and hinder talent retention.

4. Development of a framework for an integrated service system combining medical treatment, nursing care, and support services for elderly patients with chronic diseases

4.1. Framework development approach

Adhering to the principles of demand orientation, problem-oriented approach, adaptation to local conditions, and collaborative development, this framework adopts a unified core structure supplemented by region-specific modules, balancing systemic standardization with urban-rural compatibility. It aims to establish a closed-loop integrated medical-care-and-nursing service system characterized by government guidance, institutional leadership, community support, and broad public participation.

4.2. Four-dimensional integrated service system architecture

4.2.1. Dimension of collaboration among service providers

Clarify the responsibilities and authorities of multiple stakeholders: The government is responsible for top-level planning, policy formulation, resource coordination, and industry supervision; medical institutions undertake chronic disease screening, diagnosis, treatment, rehabilitation, and technical guidance; elderly care facilities provide day care services and centralized elderly care services; urban and rural communities are responsible for demand assessment, service coordination, and health education; professional nursing teams handle home-based rehabilitation and chronic disease monitoring; families fulfill daily care responsibilities. Establish a cross-departmental joint meeting system to create a collaborative framework with clearly defined roles and smooth coordination.

4.2.2. Dimension of service content integration

The system integrates five major service sectors: Basic healthcare includes chronic disease screening, physical examinations and diagnosis/treatment, and medication guidance; Rehabilitation care covers postoperative physiotherapy, functional training, and home-based care; Daily living assistance encompasses meal assistance, bathing support, day care services, and home companionship; Health support comprises health education, psychological counseling, and hospice care; Smart services leverage intelligent devices for real-time monitoring of chronic conditions, AI-based early warnings, and remote follow-ups, ensuring comprehensive service coverage throughout the entire process [7].

4.2.3. Dimensions for service process optimization

Establish a closed-loop process encompassing demand assessment, solution customization, service implementation, outcome feedback, and dynamic adjustment. Conduct home visits to evaluate care levels and needs, develop personalized integrated medical-care-protection plans, implement services through multi-party collaboration, regularly conduct satisfaction and health outcome evaluations, dynamically optimize service content, and achieve precise care delivery.

4.2.4. Dimension of service resource support

Establish a health and wellness information sharing platform for the nine cities along the Yellow River, integrating data resources such as medical beds, elderly care facilities, and nursing personnel, to create a chronic disease health information database for the elderly and break down information barriers between institutions, communities, and regulatory authorities. Promote contractual collaborations between primary healthcare institutions and elderly care facilities to optimize underutilized resources and achieve shared development of facilities, talent, and services.

4.3. Differentiated implementation approaches for urban and rural areas

At the city level, a "high-end integrated" service model is established, featuring medical-care and wellness complexes as well as community-integrated service centers to meet high-quality personalized care needs; at the county and township levels, a "basic inclusive" service network is developed, centered around county and township medical institutions and extending to village-level service stations to ensure basic diagnosis, treatment, and rehabilitation care; in rural areas, a "simple baseline" service model is implemented, leveraging village clinics and village committees to conduct regular outpatient visits, promote neighborhood mutual assistance, and provide volunteer support, thereby meeting essential care demands [8].

5. A long-term guarantee mechanism for the integrated healthcare, nursing, and elderly care system

5.1. Policy support

Formulate detailed implementation rules for the integrated medical-care-rehabilitation services in Yellow River regions, standardizing industry service standards and access requirements; eliminate policy barriers between health, civil affairs, and medical insurance authorities, and expand the coverage of medical insurance for rehabilitation nursing and home-based care; implement preferential policies regarding land use, taxation, and subsidies to encourage private capital participation in healthcare and wellness services [9].

5.2. Talent support

Refine the talent development system comprising "institutional training + on-the-job training + targeted recruitment"; establish elderly care and wellness-related programs in universities; implement a regular training and certification-based employment system for grassroots practitioners; optimize compensation packages, professional title evaluation, and promotion pathways to enhance industry attractiveness and stabilize the professional workforce.

5.3. Financial guarantee

Establish a diversified financing mechanism involving government investment, social capital, public welfare, charitable contributions, and medical insurance as the safety net. Increase provincial fiscal allocations for rural health and wellness initiatives along the Yellow River; attract social capital through government procurement of services and Public-Private Partnership (PPP) models; leverage public welfare funds to support elderly individuals with severe chronic diseases in extreme poverty, ensuring sustainable service delivery [10].

5.4. Regulatory evaluation guarantees

Establish a comprehensive evaluation indicator system covering service quality, health outcomes, public satisfaction, and collaborative effectiveness, implementing dynamic monitoring and annual assessments; conduct regular supervision of institutional qualifications, service standards, and fee structures; maintain open channels for public feedback, and implement continuous improvements based on evaluation results to enhance service quality and efficiency.

6. Conclusion

The medical, nursing, and elderly care services for chronic diseases among the elderly in the Shandong section of the Yellow River Basin face practical challenges such as service fragmentation, imbalanced resource allocation, insufficient collaboration among stakeholders, talent shortages, and lagging support mechanisms. Addressing regional urban-rural disparities and grounded in the theories of holistic governance and collaborative governance, an integrated service system should be established across four dimensions, including service providers, content, processes, and supporting infrastructure, with differentiated implementation pathways tailored to urban, county, and rural areas. Long-term support mechanisms must be developed at the levels of policy, talent, funding, and supervision to effectively address the issues of disconnection between medical care and elderly care, as well as separation between nursing and long-term care services. Future efforts should focus on further investigating the varying needs of elderly populations across different cities and with varying degrees of disability, integrating big data and artificial intelligence to create intelligent medical-nursing-care models, monitoring pilot program outcomes to optimize the system framework continuously, and ultimately establishing replicable and scalable regional wellness development models that will support high-quality health service delivery for older people in the Yellow River Basin.

Disclosure statement

The authors declare no conflict of interest.

References

[1] The CPC Central Committee and the State Council, 2019, “Healthy China 2030” Planning Outline. China Oncology, 28(10): 724.

[2] The Central Committee of the Communist Party of China and the State Council, 2021, Outline of the Development Plan for Ecological Protection and High-Quality Development in the Yellow River Basin. China Water Resources,

2021(21): 3–16.

[3] General Office of the People's Government of Shandong Province, 2021, Notice on Issuing the Shandong Province "14th Five-Year Plan" for the Elderly Care Service System. Official Gazette of the People's Government of Shandong Province, 2021(25): 27–37.

[4] People's Government of Shandong Province, 2021, Notice on Issuing the Shandong Province Natural Resources Protection and Utilization Plan for the 14th Five-Year Period. Official Gazette of the People's Government of Shandong Province, 2021(28): 1–41.

[5] Dong Z, 2022, Research on Building a High-Quality Elderly Care Service System in Coastal Areas of Shandong Province to Promote the Development of the Health Industry. China Marine Economy, 7(01): 49–82.

[6] Qi G, Wang Z, Zhao N, 2022, Study on Spatial-Temporal Disparities and Driving Factors of Population Aging in the Yellow River Basin. Journal of Xi'an University of Technology, 38(03): 301–310.

[7] Zhang D, Chi L, 2023, Analyzing the Pension Issues of Elderly Landless Residents in Rural Areas of the Yellow River Basin Based on "China by the Yellow River". People's Yellow River, 45(01): 167.

[8] Xu T, Dong E, Guo L, et al., 2021, Study on the Continuity of Health Management Needs and Influencing Factors Among Elderly Patients with Chronic Diseases. China General Practice Medicine, 24(13): 1665–1670.

[9] Sun B, Dong X, Zeng X, 2026, Ethical Dilemmas and Governance Strategies of the Integrated Medical and Elderly Care Model. China Medical Ethics, 39(01): 113–120.

[10] Qin S, Zhou M, Cheng Y, et al., 2024, Choice Preference of Middle-Aged and Elderly People on Integrated Medical Services and Elderly Care Model: A Cross-Sectional Study. Inquiry: A Journal of Medical Care Organization, Provision and Financing, 61: 469580231224345.

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Online Health Information Seeking Behavior Among Patients with Diabetes: The Mechanisms of Information Overload, Perceived Risk, and Health Anxiety

Ya Shao[1], Yu Wang[1], Yu Hua[1], Xu Zhou[1], Huiqin Zhong[2]*

[1]Health Management Center, Wudangshan Branch, TaiHe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China
[2]Innovation Center of Nursing Research, TaiHe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China

***Corresponding author**: Huiqin Zhong, zhq66077@163.com

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Abstract: *Objective*: To explore the characteristics of online health information seeking behavior among diabetic patients, identify its influencing factors, and reveal the underlying mechanisms, thereby providing a theoretical basis for optimizing health information service platforms and enhancing patients' information literacy. *Methods*: A mixed-methods research design was employed. First, qualitative analysis through in-depth interviews (n = 15) was conducted to examine diabetic patients' online information-seeking processes, exploring how antecedent factors such as information overload and perceived risk influence patients' information-seeking behavior through the mediating role of health anxiety. Second, through literature analysis and theoretical derivation, an integrated model of online health information-seeking behavior among diabetic patients was constructed based on the CAC (Cognitive-Affective-Behavioral) theoretical framework. *Results*: The study identified four key characteristics of patients' online information-seeking: (1) Information-seeking is multifaceted and progressive, evolving from symptom recognition to disease management needs; (2) Patients commonly face information overload dilemmas, struggling to distinguish information authenticity and quality, with significant advertising interference; (3) Perceived risks (medical pitfalls, privacy breaches) and information overload mutually reinforce each other, triggering health anxiety; (4) Health anxiety simultaneously drives active information-seeking and leads to over-reliance and decision difficulties. The proposed integrated model indicates that information environment quality, patient information literacy, and platform design are three critical factors influencing information-seeking efficacy. *Conclusion*: The transition of patients from passive recipients of medical guidance to active self-managers is an important global health trend; however, this transition faces structural barriers. Optimizing the online health information ecosystem, enhancing patient information literacy, and establishing information credibility assessment mechanisms are important pathways to improve patients' information-seeking efficacy.

Keywords: Diabetic patients; Online health information seeking; Information overload; Perceived risk; Health anxiety; Mixed-methods research

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1. Introduction

Diabetes has become a global public health problem. According to the latest data from the International Diabetes Federation (IDF), there were approximately 589 million diabetic patients worldwide in 2024, with projections reaching 783 million by 2050 [1]. China, as the country with the largest number of diabetic patients globally, had over 126 million diabetic patients in 2020, ranking first in the world [2]. The chronic nature of diabetes necessitates long-term disease self-management by patients, which involves not only medical adherence but, more importantly, the accumulation of patient knowledge and health decision-making capacity [3].

In the era of digital healthcare, the Internet has become an important channel for patients to obtain health information. Research demonstrates that over 70% of diabetic patients actively seek disease-related information through web searches, social media, health applications, and other channels [4]. Patients' active information-seeking behavior transforms them from passive subjects of medical intervention to active participants in health management, a role transition that contributes to enhanced health literacy and self-management efficacy [5]. However, the complexity of the online information environment brings concurrent challenges--uneven information quality, widespread medical misinformation, and pervasive advertising interference create unprecedented "information overload" dilemmas for patients [6].

Current research primarily focuses on analyzing the motivations and sources of information-seeking, but an in-depth understanding of the psychological barriers, risk perceptions, and emotional responses that patients encounter during information-seeking processes remains insufficient. Particularly in the Chinese context, there is a lack of systematic research on the online health information-seeking behavior of diabetic patients. Therefore, the core research questions addressed in this study are: How do diabetic patients make decisions under the dual pressure of information overload and perceived risk during their online health information-seeking processes? What mediating role does health anxiety play in this dynamic?

Based on the Cognitive-Affective-Conative (CAC) integrated framework, this study positions information overload and perceived risk as antecedent factors in patients' information-seeking behavior, introduces health anxiety as an affective mediating variable, and systematically explores how these factors interact to influence patients' online information-seeking behavior and decision-making quality. Through a mixed-methods research design combining qualitative interviews with theoretical analysis, this study aims to develop an in-depth understanding of patients' lived experiences and psychological mechanisms, ultimately providing evidence for optimizing health information services and improving patients' information acquisition experiences.

2. Literature review and theoretical framework

Health information seeking is a process by which patients actively acquire, evaluate, and utilize health information to address health problems [7]. In the era of widespread internet access, patients increasingly tend to seek health information online, a phenomenon particularly pronounced among patients with chronic diseases [8]. Diabetes, as a globally prevalent metabolic disease, confronts patients with sustained pressures of self-management and treatment decision-making, creating persistent and urgent needs for health information [9].

This study employs an integrated CAC framework to explain patients' online health information-seeking behavior. The cognitive dimension focuses on patients' understanding and evaluation of disease, treatment options, and information sources; the affective dimension emphasizes psychological factors such

as health anxiety and perceived risk in driving information seeking [10]. The behavioral dimension manifests in concrete strategies and decision-making patterns patients employ during information seeking. This framework effectively integrates patients' rational cognition, affective needs, and actual behavior, providing a comprehensive perspective for understanding the complex information-seeking process.

In the specific manifestations of information seeking, patients frequently encounter core challenges including information overload, perceived risk, and health anxiety [11]. Information overload refers to situations where the volume of information obtained through online searches exceeds patients' processing capacity, leading to decision difficulty; perceived risk reflects patients' concerns about the accuracy and safety of online health information; health anxiety stems from fears of disease progression and uncertainty. These three factors interact to influence patients' ultimate decisions and behaviors [12]. A deeper understanding of these factors and their interactive mechanisms contributes to improving patient education strategies and the design of medical information services.

3. Research methods

This study employed a qualitative research design to obtain authentic insights into how patients with diabetes seek online health information. Using purposive sampling, we recruited 20 participants diagnosed with type 1 or type 2 diabetes, aged 18-65 years, who were able to clearly articulate their experiences with online health information seeking. Participants came from diverse geographical locations, educational backgrounds, and disease progression stages to ensure sample diversity and representativeness.

Data collection was conducted through semi-structured in-depth interviews, each lasting 45-90 minutes, structured around four core dimensions:

(1) Patients' information needs and seeking frequency;
(2) Cognitive assessment during the information-seeking process, such as evaluating source credibility and content relevance;
(3) Emotional experiences, such as health anxiety and perceived information overload; and
(4) Final decision-making behaviors and healthcare choices [13]. All interviews were audio-recorded with participants' consent and subsequently transcribed verbatim.

Data analysis employed thematic analysis methodology with a three-stage iterative coding process [14]: First, open coding was conducted to extract primary concepts from the data line-by-line; second, axial coding was performed to cluster related concepts into sub-themes; and third, selective coding was applied to integrate themes within the CAC theoretical framework, constructing a comprehensive model of patients' information-seeking behaviors. To ensure research credibility, triangulation was employed by inviting three independent researchers to independently re-code portions of the data and compare coding consistency [15]. The entire process complied with ethical standards, with institutional review board approval obtained, and all participants provided informed consent. Interview data were anonymized during analysis.

4. Qualitative findings

4.1. Cognitive dimension: Tension between information needs and information overload

Interview data reveal that patients with diabetes face significant cognitive challenges in seeking online health information. Patients commonly expressed the need to acquire professional knowledge about blood glucose

control, complication prevention, and medication guidance, but frequently encountered information overload during their search processes [16]. One patient noted: "There is so much information about diabetes online, and some of it contradicts each other. I simply don't know which source to trust". This reflects the difficulty patients experience in effectively processing information from multiple sources.

The research reveals that patients' information needs demonstrate stage-specific characteristics: during the initial diagnosis period, demand for basic knowledge is most urgent, whereas in long-term management phases, patients focus more on personalized dietary and exercise recommendations. However, existing online information resources tend to be presented in generalized forms, failing to meet patients' stratified needs. Patients prefer to filter information through doctor recommendations, patient forums, and official medical websites, yet the consistency and authority of these channels remain variable [17].

4.2. Affective dimension: Perceived risk and the drivers of health anxiety

Affective factors play a pivotal role in patients' information-seeking behaviors. During interviews, most patients expressed concerns about complications and uncertainty regarding treatment efficacy. This perceived risk directly drives patients' active search for online information. One patient stated: "Whenever I see that a certain organ might develop problems, I immediately search online, wanting to understand more".

However, frequent information seeking often intensifies patient health anxiety. Interview data demonstrates that patients encountering negative cases or descriptions of severe complications online reinforce their perception of disease risk, subsequently creating a vicious cycle of anxiety-seeking-anxiety. Consequently, some patients adopt "information avoidance" strategies, deliberately reducing their attention to disease-related information to protect their psychological well-being [18].

Patients' emotional states are closely associated with their choice of information sources. When anxious, patients are more likely to believe patient experience narratives that resonate emotionally; when thinking rationally, they place greater trust in medical professionals' advice. This indicates that the interactive effects between affect and cognition shape patients' information-seeking preferences.

4.3. Behavioral dimension: Multi-channel information seeking and decision-making actions

At the behavioral level, patients' online health information seeking demonstrates multi-channel and multi-strategy characteristics. Primary information channels include search engines, medical specialty websites, patient communities, and social media. Among these, Baidu and Weibo patient communities are the most frequently used channels, though patients' trust in their information authenticity varies considerably.

The research identifies three categories of actions patients take based on information-seeking results: First, verification actions, by comparing online information with doctor advice, increasing treatment confidence when they align; Second, adjustment actions, such as modifying diet or exercise plans based on online information, though most patients consult their doctors before implementation; Third, delay actions, collecting information but postponing action pending doctor guidance.

Notably, there is a positive correlation between patients' information-seeking behaviors and the quality of doctor-patient communication. When patients are satisfied with their communication with physicians, the frequency of online information seeking is relatively lower, though searches are more targeted. This highlights the importance of healthcare providers improving their communication approaches.

Integrating findings across these three dimensions, patients' online health information-seeking behavior is not merely a cognitive process, but rather a complex phenomenon in which cognition, affect, and behavior are deeply interwoven. The CAB framework provides robust theoretical support for understanding this phenomenon.

5. Discussion and recommendations

This study reveals the complex mechanisms underlying online health information-seeking behavior among patients with diabetes through qualitative analysis. The CAB framework effectively explains the entire process from patients' cognitive needs, affective drivers, to behavioral decisions [19]. The study findings resonate with existing literature while presenting unique, novel insights.

At the cognitive level, the information overload problem faced by patients stems not only from abundant online resources but also from variations in patients' own information literacy and diversity in disease understanding. Compared to the general population, chronic disease patients' information search exhibits stronger goal-directedness and anxiety-driven characteristics [20]. This suggests that healthcare institutions should proactively provide professionally reviewed, targeted health information resources rather than passively waiting for patients to conduct independent searches.

At the affective level, the "information-seeking loop" formed by perceived risk and health anxiety deserves attention. Patients may encounter non-standard or even erroneous medical information during their search process, which further intensifies anxiety and drives more frequent searching--forming a potentially vicious psychological cycle [21]. Therefore, psychological interventions and information guidance should proceed in parallel.

At the behavioral level, multi-channel information-seeking strategies reflect patients' rational judgment--using cross-verification to circumvent biases from single information sources. However, the efficiency issue of this process cannot be overlooked: many patients spend excessive time on information discrimination rather than on disease self-management [22].

Practical Recommendations:

(1) At the clinical level, healthcare professionals should recognize the inevitability of patients' online information-seeking and establish professional guidance mechanisms rather than simply prohibiting such behavior;

(2) At the platform level, internet healthcare platforms should establish medical information review and stratification systems that emphasize authoritative sources;

(3) At the policy level, health literacy education should be integrated into primary healthcare service systems to enhance patients' information discrimination capabilities [23].

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Disclosure statement

The authors declare no conflict of interest.

References

[1] International Diabetes Federation, 2025, IDF Diabetes Atlas, 11th Edition.

[2] Saeedi P, Petersohn I, Salpea P, et al., 2019, Global and Regional Diabetes Prevalence Estimates for 2019 and Projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th Edition. Diabetes Research and Clinical Practice, 157: 107843.

[3] Misra S, Khunti K, Goyal A, et al., 2025, Managing Early-Onset Type 2 Diabetes in the Individual and at the Population Level. Lancet, 405(10497): 2341–2354.

[4] Zeng R, Li Y, 2023, Meta-Analysis of the Relationship Between Self-Efficacy and Online Health Information Seeking. Advances in Psychological Science, 31(4): 535–551.

[5] Han J, Fan W, Luo X, et al., 2018, Research Progress on the Impact of Users' Health Information-Seeking Behavior on Health Behaviors. Information and Documentation Work, 2018(2): 48–55.

[6] Wang M, Zhou C, Lin G, 2021, A Review of Research on the Impact of Online Health Information-Seeking Behavior. Knowledge Management Forum, 6(3): 158–166.

[7] Ming Y, Matteson M, Zhang Y, 2026, Relationship Between Online Health Information Acquisition and Shared Decision-Making Among Patients with Diabetes: Cross-Sectional Survey Study. Journal of Medical Internet Research, 28: e86137.

[8] Hwang H, Kim N, You J, et al., 2025, Harnessing Social Media Data to Understand Information Needs About Kidney Diseases and Emotional Experiences with Disease Management: Topic and Sentiment Analysis. Journal of Medical Internet Research, 27: e64838.

[9] Pengpid S, Peltzer K, 2024, Prevalence and Associated Factors of Depressive Symptoms Among Older Adults in the Philippines. Actas Esp Psiquiatr, 52(5): 705–715.

[10] Chen J, Duan Y, Xia H, et al., 2025, Online Health Information Seeking Behavior Among Breast Cancer Patients and Survivors: A Scoping Review. BMC Women's Health, 25(1): 1.

[11] Sundell E, Wångdahl J, Grauman Å, 2022, Health Literacy and Digital Health Information-Seeking Behavior - A Cross-Sectional Study Among Highly Educated Swedes. BMC Public Health, 22(1): 2278.

[12] Jia C, Li P, 2024, Generation Z's Health Information Avoidance Behavior: Insights from Focus Group Discussions. Journal of Medical Internet Research, 26: e54107.

[13] Wong K, Wong K, O'Brien B, et al., 2026, Reflexive Thematic Analysis. Academic Medicine, 101(6): 737–738.

[14] Bodenstein T, Kemmerling A, Kemmerling A, et al., 2026, Taking Stock of Qualitative Methods of Evaluation: A Study of Practices and Quality Criteria. Evaluation Review, 50(1): 89–115.

[15] Pong C, Roberts N, Lum E, 2024, The "What, Why, and How?" of Story Completion in Health Services Research: A Scoping Review. BMC Medical Research Methodology, 24(1): 159.

[16] Kishore Kumar C, Premaraja R, Arulraja S, et al., 2026, Scope and Prospects of Social Media for Patient Education and Engagement in Medical Practice. Cureus, 18(4): e106411.

[17] Bendig E, Bauereiß N, Ebert D, et al., 2018, Internet-Based Interventions in Chronic Somatic Disease. Deutsches Ärzteblatt International, 115(40): 659–665.

[18] Andrade A, Di Girolamo Martins G, Scatena A, et al., 2022, The Effect of Psychosocial Interventions for Reducing Co-Occurring Symptoms of Depression and Anxiety in Individuals with Problematic Internet Use: A Systematic Review and Meta-Analysis. International Journal of Mental Health and Addiction, (online): 1–22.

[19] Last B, Schriger S, Timon C, et al., 2021, Using Behavioral Insights to Design Implementation Strategies in Public Mental Health Settings: A Qualitative Study of Clinical Decision-Making. Implementation Science

Communications, 2(1): 6.

[20] Ou Z, Wei J, Guo Y, et al., 2026, Information Overload, Cognitive Fusion, and Health Literacy Among Individuals with Type 2 Diabetes: A Moderated Network Analysis. Scientific Reports, 16(1): 4203.

[21] McMullan R, Berle D, Arnáez S, et al., 2019, The Relationships Between Health Anxiety, Online Health Information Seeking, and Cyberchondria: Systematic Review and Meta-Analysis. Journal of Affective Disorders, 245: 270–278.

[22] Soroya S, Farooq A, Mahmood K, et al., 2021, From Information Seeking to Information Avoidance: Understanding the Health Information Behavior During a Global Health Crisis. Information Processing & Management, 58(2): 102440.

[23] Karamitros G, Karamitrou I, Grant M, et al., 2025, The Intersection of Quality and Readability in Online Health Information: Implications for Patient Education—A Critical Perspective. Dermatologic Surgery, 51(6): 653–654.

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Hotspots and Frontiers in Labor Analgesia Nursing Research: A CiteSpace-Based Visual Analysis

Yingying Nie†, Xian Chen†, Qian Ye, Shaoxin Kong*

Department of Obstetrics, The Third Affiliated Hospital of Sun Yat-sen University, Zhaoqing Hospital, Zhaoqing 526000, Guangdong, China
† These authors contributed equally to this work and share the first authorship.

*Corresponding author: *Shaoxin Kong, 13827564607@163.com*

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Abstract: *Background*: Labor analgesia nursing is an important component of intrapartum care, involving pain management, maternal experience, and health outcomes. However, the knowledge structure, research hotspots, and emerging trends in this field have not been systematically explored. This study aimed to analyze the current status, hotspots, and frontiers of labor analgesia nursing research using bibliometric methods. *Methods*: Relevant publications were retrieved from the Web of Science Core Collection using the search strategy TS = ((“labor analgesia” OR “labor pain relief” OR “obstetric analgesia”) AND (nursing OR midwifery OR “intrapartum care”)). The time span was from January 1, 2000, to December 31, 2025, and the search was conducted on March 1, 2026. After screening, 72 eligible publications were included. CiteSpace 6.4.R1 was used to analyze annual publication trends, collaboration networks of authors, institutions, and countries/regions, as well as keyword co-occurrence, clustering, and burst patterns. *Results*: The annual number of publications showed an overall upward trend and reached a peak in 2025. The United States occupied the central position in the country/region collaboration network, whereas collaboration among authors and institutions remained relatively scattered. Lim, Grace, was the most prominent author, and the Pennsylvania Commonwealth System of Higher Education was the leading institution. High-frequency keywords mainly included epidural analgesia, fentanyl, labor analgesia, anesthesia, obstetric analgesia, cesarean delivery, nitrous oxide, and bupivacaine. Keyword clustering indicated that the field mainly focused on analgesic drugs, analgesic techniques, obstetric outcomes, and related clinical research topics. Recent burst keywords included health, childbirth satisfaction, obstetric analgesia, and labor. *Conclusions*: Labor analgesia nursing research has expanded steadily over the past two decades. Current studies mainly focus on pharmacological analgesia, obstetric outcomes, and maternal experience, while recent frontiers emphasize health outcomes and childbirth satisfaction.

Keywords: Labor analgesia; Nursing; Intrapartum care; Bibliometric analysis; CiteSpace

Online publication: Jun 30, 2026

1. Introduction

Labor pain is one of the most intense forms of pain experienced by women and remains a central concern in intrapartum care [1,2]. Effective pain relief during childbirth is not only associated with maternal comfort, but also with childbirth satisfaction, perceived control, and the overall birth experience [2,3]. Contemporary labor analgesia encompasses pharmacological and non-pharmacological approaches, among which neuraxial techniques, especially epidural analgesia, are generally regarded as the most effective pharmacological methods [1,4]. At the same time, non-pharmacological strategies such as relaxation, massage, hydrotherapy, acupuncture, and continuous labor support continue to attract increasing attention because of their safety, acceptability, and alignment with woman-centered maternity care models [2,3,5,6].

Despite major advances in obstetric anesthesia, labor analgesia is not solely a technical or anesthetic issue; it is also a nursing and midwifery issue [5,7,8]. Nurses and midwives play indispensable roles in pain assessment, intrapartum support, analgesia-related education, monitoring of maternal and fetal responses, implementation of non-pharmacological interventions, and coordination of multidisciplinary care in the labor ward [6–8]. Previous evidence has shown that women's experiences of labor pain relief are shaped not only by analgesic efficacy, but also by professional support, communication, expectations, and the care environment [3,6]. Furthermore, barriers at the health system, facility, practitioner, and consumer levels may hinder the implementation of non-pharmacological pain management in maternity settings [6]. These findings highlight that labor analgesia nursing research has evolved into a multidimensional field involving clinical effectiveness, care models, patient experience, and organizational practice [3,5–7].

Over the past two decades, the literature on labor analgesia has expanded substantially, covering epidural techniques, systemic analgesics, non-pharmacological methods, maternal satisfaction, safety, and delivery outcomes [1,2,4,5,8]. However, most existing studies have focused on the efficacy and safety of specific interventions, while comparatively less attention has been paid to the overall intellectual structure, research collaboration patterns, evolving hotspots, and emerging frontiers of labor analgesia nursing research as a whole [1,3,5,8]. Traditional narrative reviews and systematic reviews are valuable for answering focused clinical questions, but they are less suited to identifying macro-level research trends and knowledge evolution across a broad interdisciplinary field [2,5,9].

Bibliometric analysis provides a quantitative approach for mapping a research field, identifying influential contributors and institutions, and detecting thematic evolution over time [9]. CiteSpace is a widely used visualization tool for knowledge-domain analysis that can reveal co-citation networks, keyword co-occurrence patterns, and burst terms, thereby helping researchers identify research hotspots and frontier topics [9]. Therefore, a bibliometric study of labor analgesia nursing research is warranted [3,5,9]. By using CiteSpace to analyze the relevant literature, the present study aims to systematically characterize publication trends, major contributors, research hotspots, and emerging frontiers in this field, and to provide evidence-based directions for future nursing practice and research in labor analgesia [9].

2. Method

2.1. Data source

The data for this study were obtained from the Web of Science Core Collection. Advanced search was conducted using the following strategy: TS = (("labor analgesia" OR "labor pain relief" OR "obstetric analgesia") AND (nursing OR midwifery OR "intrapartum care")); language limited to English; and a time

span from January 1, 2000, to December 31, 2025. The search was performed on March 1, 2026. To ensure the quality of literature selection, two researchers independently screened all retrieved records, and any disagreements were resolved through discussion. Conference papers and publications deemed irrelevant after reviewing the titles and abstracts were excluded. Finally, a total of 72 eligible publications were included in the analysis.

2.2. Research methods

The retrieved literature was saved in RefWorks format and imported into CiteSpace (version 6.4.R1) for bibliometric and visual analysis. The analysis included the annual publication output trend, country/region collaboration networks, author and institutional collaboration networks, keyword co-occurrence analysis, keyword clustering, and keyword burst detection. Parameter settings were as follows: for country/region, author, and institutional collaboration analysis, the time span was set to 2000–2025 with a one-year slice, and the node types were set to "country", "author", and "institution", respectively, while other parameters remained at their default values. For keyword analysis, the slice length was set to two years, the node type was set to "keyword", the top 100 keywords were selected for each slice, and the pruning options "pathfinder" and "pruning merged network" were applied. Keyword co-occurrence maps, clustering timeline views, and burst detection maps were generated, with all other settings kept as default.

3. Result

3.1. Annual publication numbers and trends over the past decade

As shown in Figure 1, the annual number of publications on labor analgesia nursing generally exhibited an upward trend, despite some fluctuations, from 2000 to 2025. In the early years, publication output was relatively low, with only 1 article published annually in 2000–2002. The number increased to 4 in 2003, then remained at a relatively modest level for several years. Since 2010, the number of publications has gradually increased. After a brief decline in 2013, publication output rose again and reached 5 in 2016. Although the number fluctuated between 2 and 4 during 2017–2019, a more obvious growth trend was observed in recent years. The annual number of publications reached 8 in 2021 and peaked at 12 in 2025. These results suggest that research on labor analgesia nursing has expanded steadily, with particularly increased attention during the last decade.

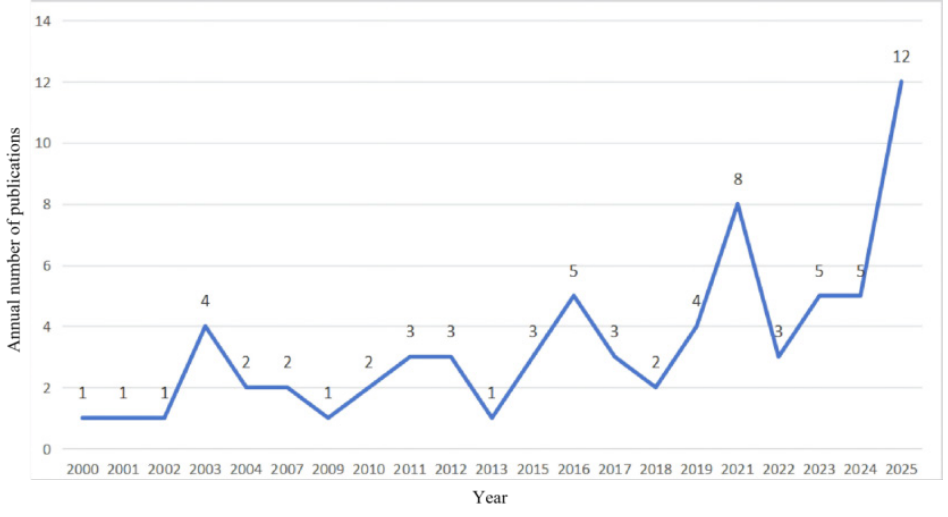


Figure 1. Annual number of publications on labor analgesia nursing from 2000 to 2025.

3.2. Analysis of author collaboration network

Figure 2 presents the author co-occurrence network in labor analgesia nursing research. The network comprised 263 nodes and 498 links, with a density of 0.0156, indicating a relatively scattered collaboration pattern. Among the authors, Lim Grace was the most prominent node. Other visible authors included Garcia-Martinez, Olga, Ramos-Torrecillas, Javier, Plante, Lauren, Herrera-Gomez, Antonio, Tassew, Worku Chekol, Rooks, Judith P, Ruiz, Concepcion, De Luna-Bertos, Elvira, and Gonete, Yosef Aragaw. Overall, several small collaborative groups were observed, but no stable core author team had yet formed. The low network density suggests that collaboration among authors in this field remains relatively limited.

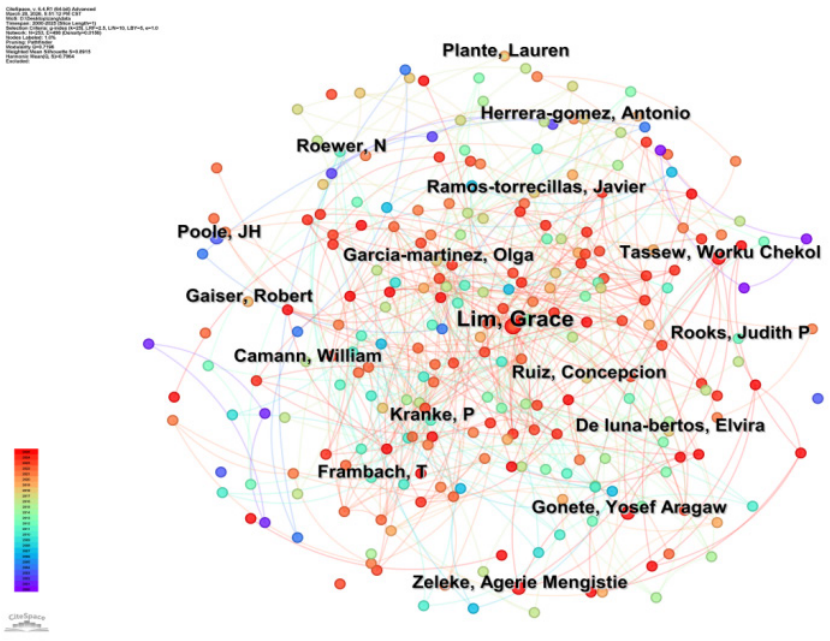


Figure 2. Author collaboration network in labor analgesia nursing research.

3.3. Institutional co-occurrence analysis

Figure 3 shows the institutional co-occurrence network of labor analgesia nursing research. The network included 128 institutions and 183 links, with a density of 0.0225, indicating relatively limited inter-institutional collaboration. Among all institutions, the Pennsylvania Commonwealth System of Higher Education (PCSHE) had the most prominent node. Other major institutions included Brigham & Women's Hospital, Harvard University, Harvard University Medical Affiliates, Columbia University, University of Pittsburgh, University of Pennsylvania, and Stanford University. Overall, several institutions formed collaborative links, but the network structure was relatively scattered, and no highly integrated institutional collaboration system was observed.

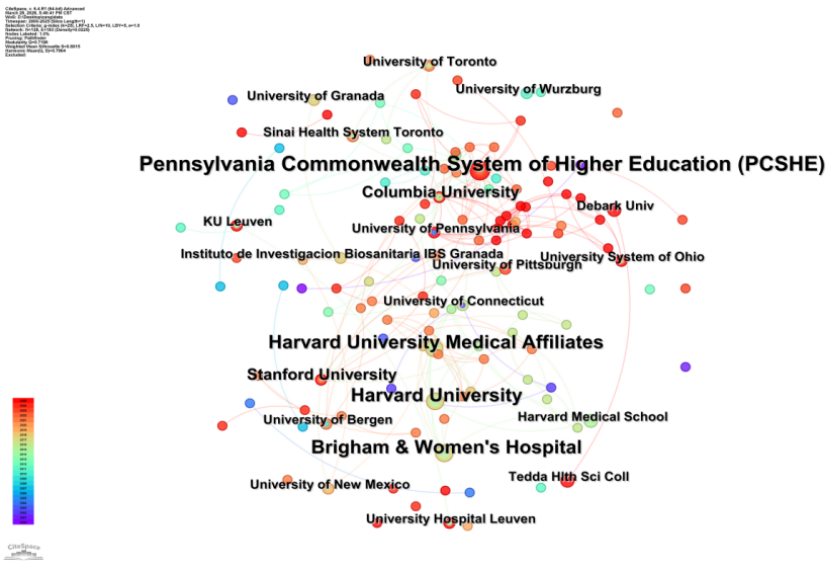


Figure 3. Institutional collaboration network in labor analgesia nursing research.

3.4. Country/region co-occurrence analysis

Figure 4 shows the country/region co-occurrence network of labor analgesia nursing research. The network consisted of 10 nodes and 10 links, with a density of 0.2222, suggesting a moderate level of collaboration among countries/regions. The USA was the most prominent country in the network and occupied the central position. Other active countries/regions included the People's Republic of China, Canada, Japan, England, and Germany. In addition, Norway, Spain, Belgium, and Ethiopia also appeared in the network. Overall, the USA maintained the closest collaborative links with multiple countries/regions, indicating its leading role in this field. Although international collaboration was observed, the number of participating countries/regions remained relatively limited.

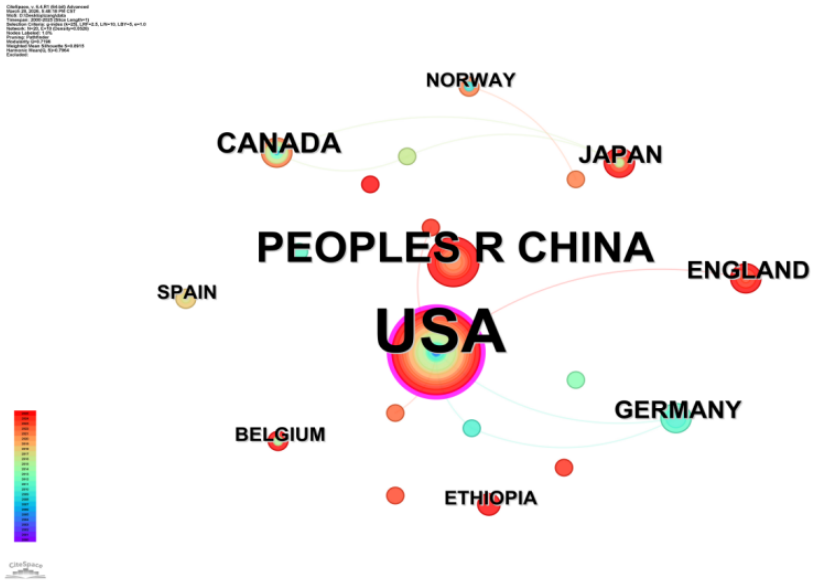


Figure 4. Country/region collaboration network in labor analgesia nursing research.

3.5. Keyword co-occurrence analysis

Figure 5 shows the keyword co-occurrence network of labor analgesia nursing research. The network contained 254 nodes and 851 links, with a density of 0.0265, indicating close relationships among keywords in this field. The high-frequency keywords mainly included epidural analgesia, fentanyl, labor analgesia, anesthesia, obstetric analgesia, cesarean delivery, nitrous oxide, bupivacaine, randomized controlled trial, delivery, pain, childbirth, and expectations. These keywords reflected the major research topics in labor analgesia nursing, including analgesic methods, drug use, obstetric outcomes, and maternal experience. Overall, epidural analgesia, fentanyl, labor analgesia, and anesthesia were the most prominent keywords in the network, indicating that they were the main focus of this research field.

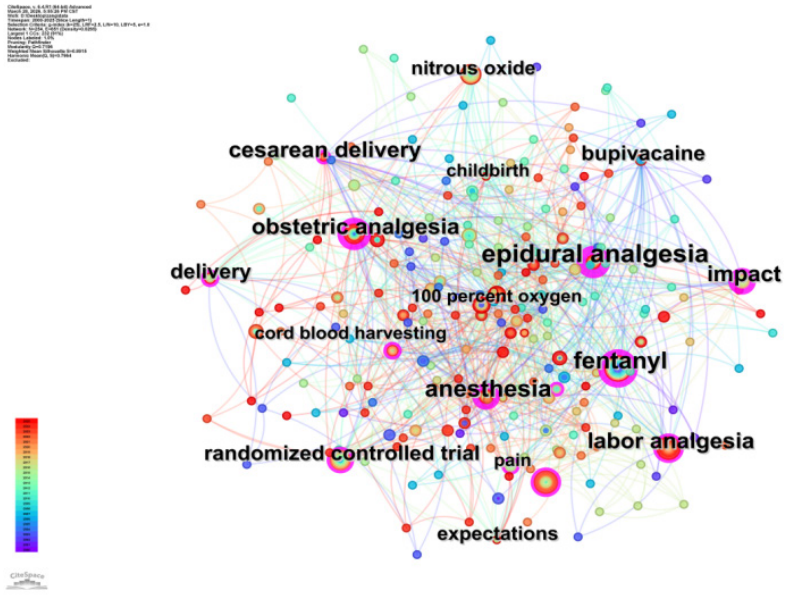


Figure 5. Keyword co-occurrence network in labor analgesia nursing research.

3.6. Keyword clustering analysis

Figure 6 shows the keyword clustering network of labor analgesia nursing research. A total of 12 major clusters were identified, including labor analgesia, bupivacaine, delivery outcome, prenatal employment, obstetric analgesia, double blind, nitrous oxide, drug-drug interactions, human microbiome, complementary, and opioid use disorder. The modularity Q was 0.7196, and the weighted mean silhouette S was 0.8915, indicating good clustering quality. Among them, labor analgesia was the largest cluster. The clustering results suggest that this field mainly focuses on analgesic drugs, analgesic techniques, obstetric outcomes, and related clinical research topics.



Figure 6. Keyword clustering network in labor analgesia nursing research.

3.7. Keyword burst analysis

Figure 7 presents the top 25 keywords with the strongest citation bursts in labor analgesia nursing research from 2000 to 2025. The burst keywords varied across different periods. Early burst terms mainly included fetal heart rate, maternal mortality, and fetal bradycardia. In the middle period, keywords such as delivery, pain, impact, instrumental delivery, and labor analgesia showed strong burst activity. In recent years, health, childbirth satisfaction, obstetric analgesia, and labor emerged as the latest burst keywords and remained active through 2025. Overall, the burst analysis shows that the research focus in this field has changed over time, with recent attention concentrated on health, childbirth satisfaction, and obstetric analgesia.

Top 25 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2000 - 2025
fetal heart rate	2001	0.68	**2001**	2001	
maternal mortality	2003	1.25	**2003**	2003	
united states	2000	1.18	**2003**	2003	
fetal bradycardia	2003	1.16	**2003**	2004	
duration	2010	0.68	**2010**	2010	
circadian changes	2010	0.68	**2010**	2010	
childbirth	2011	1.07	**2011**	2012	
patient simulation	2013	0.68	**2013**	2013	
simulation	2013	0.68	**2013**	2013	
serious games	2013	0.68	**2013**	2013	
problem-based learning	2013	0.68	**2013**	2013	
community networks	2013	0.68	**2013**	2013	
medical education	2013	0.68	**2013**	2013	
delivery	2003	2.06	**2015**	2016	
metaanalysis	2015	1.1	**2015**	2016	
pain	2004	0.81	**2015**	2016	
impact	2001	1.26	**2016**	2018	
instrumental delivery	2017	1.23	**2017**	2018	
women	2003	1.1	**2017**	2017	
labor analgesia	2002	0.87	**2019**	2019	
cesarean delivery	2001	0.72	**2021**	2021	
health	2023	1.14	**2023**	2025	
childbirth satisfaction	2024	1.06	**2024**	2025	
obstetric analgesia	2003	0.94	**2024**	2025	
labor	2011	0.89	**2024**	2025	

Figure 7. Top 25 keywords with the strongest citation bursts in labor analgesia nursing research from 2000 to 2025.

4.Discussion

The present bibliometric analysis showed that research on labor analgesia nursing has increased overall during the past two decades, although the annual output fluctuated across years. This trend suggests that labor analgesia has gradually evolved from a relatively narrow anesthetic topic into a broader field involving intrapartum nursing, midwifery care, maternal experience, and health-service quality [10,11]. This interpretation is consistent with international recommendations that emphasize both effective pain relief and a positive childbirth experience, as well as with clinical guidance supporting equitable access to labor analgesia and the active participation of trained labor nurses in analgesia management [10,11].

In the present study, epidural analgesia, anesthesia, fentanyl, bupivacaine, and obstetric analgesia were among the most prominent keywords, indicating that pharmacological analgesia remains the core knowledge domain in this field. This finding is unsurprising because neuraxial techniques continue to represent the main clinical approach to labor pain relief in modern obstetric practice [11,12]. A meta-analysis of randomized controlled trials showed that epidural labor analgesia with low concentrations of local anesthetics was not associated with a significant increase in cesarean delivery, instrumental birth, or prolongation of the second stage of labor, which may explain why bupivacaine-related and obstetric outcome-related themes remained central in the keyword clusters [12]. The persistence of clusters such as double blind and randomized controlled trials further indicates that labor analgesia nursing research is still strongly driven by intervention-based clinical evaluation [12].

Another notable finding was the appearance of nitrous oxide, complementary approaches, and childbirth-related experience terms in the keyword network and clusters, suggesting that the field is no longer confined to epidural techniques alone. Previous evidence has shown that nonpharmacologic interventions, including support-based, behavioral, and sensory approaches, may reduce epidural use and obstetric intervention while improving maternal satisfaction [13]. Similarly, continuous support during childbirth has been associated with increased spontaneous vaginal birth, shorter labor, reduced use of regional analgesia, and fewer negative birth experiences [14]. The growing visibility of nitrous oxide in our analysis also reflects the expanding interest in alternative analgesic options that may offer greater mobility and perceived control during labor [15]. Importantly, maternal satisfaction with nitrous oxide has been reported to remain relatively high even when analgesic effectiveness is lower than that of neuraxial analgesia, indicating that pain relief is only one component of women's evaluation of labor care [15,16].

The burst analysis further showed that recent frontier topics have shifted toward health, childbirth satisfaction, obstetric analgesia, and labor. This shift is clinically meaningful because contemporary intrapartum care increasingly values patient-reported outcomes rather than focusing solely on technical success or pain scores [10,17]. A classic systematic review found that women's satisfaction with childbirth is strongly influenced by caregiver support, the quality of the caregiver–patient relationship, involvement in decision-making, and whether expectations are met [17]. A later systematic review and meta-analysis likewise showed that supporting women during birth and minimizing unnecessary intervention were among the most effective strategies for creating a positive childbirth experience [18]. In addition, lower birth satisfaction has been associated with a higher risk of postpartum depression, suggesting that childbirth experience is closely linked to maternal mental health outcomes [19]. Notably, a recent systematic review did not demonstrate a clear overall correlation between pharmacological pain relief alone and women's birth experience because of marked methodological heterogeneity, further supporting the need for future research to integrate analgesic

efficacy with communication, support, and shared decision-making [20].

The collaboration maps in this study showed that the USA occupied a central position, whereas author- and institution-level collaboration remained relatively scattered. The prominent position of the USA may be related to the fact that major practice guidance and a substantial body of obstetric anesthesia research have been generated in North America [11,15]. At the same time, the low-density collaboration networks suggest that labor analgesia nursing research has not yet formed a stable, highly integrated international research community. This fragmentation may reflect the inherently interdisciplinary nature of the field, which now requires coordination among obstetrics, anesthesiology, nursing, midwifery, and, in selected populations, addiction medicine [11,21]. The emergence of opioid use disorder as a cluster term in our analysis is particularly noteworthy because recent multidisciplinary consensus statements have highlighted the complexity of peripartum pain management in pregnant patients with opioid use disorder and the need for individualized, team-based care [21]. Moreover, evidence from low-risk pregnancy populations suggests that midwife-led models are associated with fewer obstetric interventions and favorable maternal and neonatal outcomes, underscoring the importance of strengthening collaborative care pathways in future labor analgesia nursing research [22].

This study also has several limitations. First, only articles indexed in the Web of Science Core Collection and published in English were included, which may have led to the omission of relevant studies from other databases and languages. Second, bibliometric analysis mainly reflects publication characteristics, co-occurrence relationships, and citation patterns, but does not directly assess study quality or clinical effect size. Third, some cluster labels were generated automatically by the software and may not fully capture the complete clinical meaning of the underlying literature. Despite these limitations, the present study provides a structured overview of the development, core themes, and emerging trends of labor analgesia nursing research.

5.Conclusion

Overall, our findings suggest that labor analgesia nursing research is moving from a predominantly technique- and drug-centered paradigm toward a more integrated model that combines analgesic effectiveness, maternal satisfaction, health outcomes, and woman-centered care. Future studies should strengthen multicenter and multidisciplinary collaboration, focus on high-quality comparative research, and pay greater attention to patient-reported outcomes and special populations, so as to provide stronger evidence for optimizing labor analgesia nursing practice.

Data availability statement

The data used in this study were retrieved from the Web of Science Core Collection. All bibliographic records included are publicly available and can be accessed using the described search strategy.

Ethics statement

This study did not involve human participants, animals, or identifiable personal data. All data were obtained from publicly accessible bibliographic databases; therefore, ethical approval and informed consent were not

required.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Halliday L, Nelson S, Kearns R, 2022, Epidural Analgesia in Labor: A Narrative Review. International Journal of Gynecology & Obstetrics, 159(2): 356–364.

[2] Jones L, Othman M, Dowswell T, et al., 2012, Pain Management for Women in Labor: An Overview of Systematic Reviews. Cochrane Database of Systematic Reviews, 2012(3): CD009234.

[3] Thomson G, Feeley C, Hall Moran V, et al., 2019, Women's Experiences of Pharmacological and Non-Pharmacological Pain Relief Methods for Labor and Childbirth: A Qualitative Systematic Review. Reproductive Health, 16(1): 71.

[4] Anim-Somuah M, Smyth R, Cyna A, Cuthbert A, 2018, Epidural Versus Non-Epidural or No Analgesia for Pain Management in Labor. Cochrane Database of Systematic Reviews, 5(5): CD000331.

[5] Zuarez-Easton S, Shalev E, Salim R, et al., 2023, Pharmacologic and Nonpharmacologic Options for Pain Relief During Labor: An Expert Review. American Journal of Obstetrics and Gynecology, 228(5S): S1246–S1259.

[6] Ingram M, Pratt K, Bull C, 2022, The Barriers to Offering Non-Pharmacological Pain Management as an Initial Option for Laboring Women: A Review of the Literature. European Journal of Midwifery, 6: 37.

[7] Vargens O, Silva A, Progianti J, 2013, Non-Invasive Nursing Technologies for Pain Relief During Childbirth—The Brazilian Nurse Midwives' View. Midwifery, 29(11): e99–e106.

[8] Smith A, Laflamme E, Komanecky C, 2021, Pain Management in Labor. American Family Physician, 103(6): 355–364.

[9] Synnestvedt M, Chen C, Holmes J, 2005, CiteSpace II: Visualization and Knowledge Discovery in Bibliographic Databases. AMIA Annual Symposium Proceedings, 2005: 724–728.

[10] World Health Organization, 2018, WHO Recommendations: Intrapartum Care for a Positive Childbirth Experience. Geneva: World Health Organization.

[11] American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—Obstetrics, 2019, ACOG Practice Bulletin No. 209: Obstetric Analgesia and Anesthesia. Obstetrics & Gynecology, 133(3): e208–e225.

[12] Wang T, Sun S, Huang S, 2017, Effects of Epidural Labor Analgesia with Low Concentrations of Local Anesthetics on Obstetric Outcomes: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Anesthesia & Analgesia, 124(5): 1571–1580.

[13] Chaillet N, Belaid L, Crochetière C, et al., 2014, Nonpharmacologic Approaches for Pain Management During Labor Compared with Usual Care: A Meta-Analysis. Birth, 41(2): 122–137.

[14] Bohren M, Hofmeyr G, Sakala C, et al., 2017, Continuous Support for Women During Childbirth. Cochrane Database of Systematic Reviews, 7(7): CD003766.

[15] Broughton K, Clark A, Ray A, 2020, Nitrous Oxide for Labor Analgesia: What We Know to Date. Ochsner Journal, 20(4): 419–421.

[16] Richardson M, Lopez B, Baysinger C, et al., 2017, Nitrous Oxide During Labor: Maternal Satisfaction Does Not Depend Exclusively on Analgesic Effectiveness. Anesthesia & Analgesia, 124(2): 548–553.

[17] Hodnett E, 2002, Pain and Women's Satisfaction with the Experience of Childbirth: A Systematic Review. American Journal of Obstetrics and Gynecology, 186(5 Suppl Nature): S160–S172.

[18] Taheri M, Takian A, Taghizadeh Z, et al., 2018, Creating a Positive Perception of Childbirth Experience: Systematic Review and Meta-Analysis of Prenatal and Intrapartum Interventions. Reproductive Health, 15(1): 73.

[19] Urbanová E, Škodová Z, Bašková M, 2021, The Association Between Birth Satisfaction and the Risk of Postpartum Depression. International Journal of Environmental Research and Public Health, 18(19): 10458.

[20] Ugarph Edfeldt M, Gustavsson H, Hildén K, et al., 2025, Pharmacological Pain Relief and Women's Birth Experience: A Systematic Review. BMC Pregnancy and Childbirth, 25(1): 505.

[21] Lim G, Carvalho B, George R, et al., 2025, Consensus Statement on Pain Management for Pregnant Patients With Opioid Use Disorder From the Society for Obstetric Anesthesia and Perinatology, Society for Maternal-Fetal Medicine, and American Society of Regional Anesthesia and Pain Medicine. American Journal of Obstetrics and Gynecology, S0002-9378(24)01183-9.

[22] Sriram S, Almutairi F, Albadrani M, 2024, Midwife-Led Versus Obstetrician-Led Perinatal Care for Low-Risk Pregnancy: A Systematic Review and Meta-Analysis of 1.4 Million Pregnancies. Journal of Clinical Medicine, 13(22): 6629.

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Research on the Implementation Dilemmas and Countermeasures of Nursing Continuing Education Policies Based on the Smith Model

Mengyao Huang[1,2,3], Rugang Liu[1,2,3]

[1]School of Health Policy and Management, Nanjing Medical University, Nanjing 211166, Jiangsu, China
[2]Laboratory of Digital Intelligence Technology and Health Governance, Nanjing Medical University, Nanjing 211166, Jiangsu, China
[3]Jiangsu Health Research Institute, Nanjing Medical University, Nanjing 211166, Jiangsu, China

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Abstract: *Objective*: This study aims to analyze the practical dilemmas encountered in the implementation of nursing continuing education policies and propose policy optimization suggestions. It provides theoretical support and practical references for optimizing the implementation path of nursing continuing education policies, improving the mechanism for the continuous development of nursing talent, and enhancing the quality of nursing professional development. *Methods*: Using the Smith Policy Implementation Model as the theoretical framework, a multidimensional analytical framework was constructed from four aspects: idealized policy, implementing agency, target group, and external environment. Combining the latest national continuing education policy documents, a questionnaire was designed, reviewed by experts, and pre-tested on a small scale. The questionnaire was revised multiple times to ensure its quality. The survey was conducted among registered nurses working at Taizhou Second People's Hospital, who completed the questionnaire anonymously online. *Results*: During the implementation of continuing education policies, approximately 29.67% of nurses reported that the latest policy introduced in 2025 (uniform 25 credits) was unreasonable, particularly unfriendly to junior nurses, and that the continuing education content lacked specificity and practicality, as well as specialization. Nearly 92.31% of nurses reported that their motivation to participate in continuing education was solely driven by the need for career advancement and regular assessments. Difficulties encountered in personal continuing education included busy clinical work schedules, fragmented learning, and boring and useless content. Nearly half (45.58%) of nurses reported a lack of continuing education resources in their hospitals, and that hospitals mandated credit fulfillment without recognizing the value of high-credit/high-education individuals. Approximately 40.58% of nurses reported that economic downturns increased family burdens, and high course fees discouraged participation in nursing continuing education. *Conclusion*: Through targeted analysis of the above four aspects, future policy formulation and implementation should focus on addressing the specificity and practicality of nursing continuing education, emphasizing specialized training in key areas; enhancing nurses' motivation to participate in nursing continuing education by diversifying and enriching learning content to increase its appeal; improving hospital educational and training resources, such as inviting renowned experts from other hospitals to teach and breaking down regional resource-sharing barriers through university-hospital collaborations; and increasing the availability of free or

low-cost continuing education options.

Keywords: Smith policy implementation model; Nursing; Continuing education; Policy; Countermeasures

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1. Introduction

As a crucial component of the nursing professional talent cultivation system, continuing nursing education can effectively enhance the quality of nursing services and ensure medical safety. In 2025, the National Health Commission issued the latest version of the "Administrative Measures for Continuing Medical Education Credits", eliminating the traditional classification of Category I/II credits and implementing a uniform standard of 25 credits annually. This move aims to streamline management processes, improve learning efficiency, and promote the comprehensive development of nursing staff [1]. This paper aims to explore the implementation challenges and countermeasures of continuing nursing education policies based on the Smith Model, providing references and insights for the implementation of similar policies in other hospitals.

2. Research design

2.1. Smith's policy implementation model

The Smith Policy Implementation Model, proposed by American scholar Thomas Smith in 1973, is one of the most influential theoretical models in the field of policy implementation research [2,3]. In this model, the policy implementation process is depicted as a dynamic system composed of four interrelated and interacting variables: idealized policy, implementing organization, target group, and external environment. The idealized policy refers to the rationality, legality, clarity, and feasibility of the policy itself, serving as the foundation and prerequisite for policy implementation. The implementing organization comprises the organization and its personnel responsible for policy execution, with organizational structure, management capabilities, resource allocation, and implementation willingness directly influencing policy implementation outcomes. The target group represents the objects directly affected by the policy, with their cognitive levels, acceptance degrees, participation willingness, and behavioral patterns significantly impacting policy implementation. The external environment encompasses external factors such as politics, economy, culture, and society that influence policy implementation, serving as crucial conditions for its success. Therefore, the Smith Model emphasizes the interactive relationships among these four variables, explicitly stating that the success of policy implementation depends on their coordination and cooperation. Consequently, when contradictions or conflicts arise among these variables, policy implementation challenges emerge.

2.2. Research methodology

This study targeted registered nurses currently employed at Taizhou Second People's Hospital, conducting an online survey via the Questionnaire Star platform. A total of 95 questionnaires were distributed, with 91 valid responses collected, yielding an effective response rate of 95.79%. The survey utilized a self-designed "Questionnaire on the Implementation of Continuing Nursing Education Policies", which comprised six

sections: basic information, policy content awareness, evaluation of implementing organizations, experiences of target groups, impacts of the external environment, and open-ended suggestions. After undergoing reviews by three nursing management experts and a small-scale pre-test involving 10 nurses, the questionnaire underwent multiple revisions and improvements based on feedback, ultimately forming the formal version. The reliability analysis of the questionnaire revealed a Cronbach's α coefficient of 0.913, indicating good internal consistency. The validity analysis demonstrated a KMO value of 0.879, a significant Bartlett's sphericity test ($p < 0.001$), and a cumulative variance explanation rate of 60.68%, indicating good structural validity of the questionnaire.

3. Research findings

3.1. Current status of continuing nursing education policy implementation

(1) Idealized policy

As the foundational condition for policy implementation, this study investigated the idealized policy from four aspects: the rationality of credit standards, the clarity of credit classification, the practicality of course content, and the strictness of policy supervision. The results are shown in **Table 1**. Although the new policy implemented in 2025 has achieved positive outcomes in simplifying management and unifying standards, with relatively high overall acceptance, significant implementation challenges persist. Firstly, the uniform design of 25 credits overlooks the heterogeneity of the nursing population, being less friendly to nurses with low seniority (1–5 years), low educational qualifications (secondary vocational/junior college), and those working in emergency/ICU departments, demonstrating insufficient group adaptability. Secondly, the course content lacks targetedness and practicality, with severe homogenization, a shortage of specialized practical content in emergency and critical care, and a disconnect from clinical needs. Notably, 50% of senior nurses (with over 20 years of experience) found the content boring. Lastly, although overall supervision is effective, lax review practices exist in emergency/ICU departments due to busy work schedules, highlighting the need to strengthen the consistency of policy supervision.

Table 1. Survey results on idealized policy

Item	Group	Number of people	Percentage (%)
Reasonableness of the 2025 credit standard	Reasonable/Very reasonable	66	72.52
	Fair/Unreasonable	24	29.67
Clarity of credit classification rules	Clear/Very clear	84	92.31
	Fair	7	7.69
Relevance and practicality of course content	Strong/Relatively strong	64	70.32
	Fair/Poor	27	29.68
Strictness of policy supervision mechanism	Strict/Relatively strict	78	85.72
	Fair/Relatively lenient	13	14.28

(2) Implementing agencies

This study investigated the policy's implementing agencies from five perspectives: the completeness of the management system, the stringency of the review process, the adequacy of resources, the timeliness of policy communication, and the reflection of salary value. The results are shown in **Table 2**. Although

the surveyed hospitals have established a relatively complete management system for nursing continuing education, there are still certain deficiencies at the implementation level. Firstly, despite the high coverage of the system, the implementation details for departments such as Emergency/ICU do not align with their work characteristics, making it difficult for the system to be effectively implemented. Secondly, there are significant differences in the implementation of the credit review process across departments ($F = 3.769$, $p = 0.007$), with the Emergency/ICU department having a relatively lenient review (mean score of 1.64), which affects the fairness of policy implementation, as shown in **Table 3**. Finally, there is a severe imbalance in the allocation of continuing education resources, with abundant resources in the surgical department and a scarcity in the Emergency/ICU department, leading to a significant gap in the comprehensive abilities of nursing staff in these two departments, as shown in **Table 4**. Additionally, although the overall policy communication is good, a few night-shift nurses experience information delays. The most prominent issue is that the salary system fails to fully reflect the value of individuals with "high credits/high abilities", with low correlations between credits, salary, and promotion, resulting in ineffective incentive mechanisms.

Table 2. Survey results of implementing agencies

Indicator	Category	Number of people	Percentage (%)
Completeness of credit management system	Established and comprehensive	85	93.41
	Not comprehensive	6	6.59
Strictness of credit review process	Very strict / Strict	86	94.50
	Average	5	5.49
Adequacy of continuing education resources	Abundant / Relatively abundant	75	82.42
	Average / Scarce	16	17.58
Timeliness of policy dissemination	Very timely / Timely	85	93.41
	Average	6	6.59
Value reflection of salary system	Very well reflected	44	48.35
	Moderately reflected	32	35.16
	Average	15	16.48

Table 3. Departmental implementation of the credit review process

Option	Sample size	Mean	Standard deviation
Internal Medicine	20	1.10	0.31
Surgery	32	1.22	0.42
Emergency/ICU	25	1.64	0.81
Outpatient	3	1.00	0.00
Others	11	1.18	0.40
F		3.769	
p		0.007	

Table 4. Allocation of continuing education resources across departments

Option	Sample size	Mean	Standard deviation
Internal Medicine	20	1.25	0.44
Surgery	32	1.50	0.67
Emergency/ICU	25	2.16	1.03

Outpatient	3	1.00	0.00
Others	11	1.91	0.70
F		5.561	
p		0.000	

(3) Target group

This study conducted a survey on the policy implementation among the target group from four aspects: the level of policy awareness, motivation for participation, learning difficulties, and channels for obtaining credits. The results are shown in **Table 5**. The surveyed nursing staff generally had a relatively high level of awareness of the policy, but there were significant issues with their participation behavior and learning experience. Firstly, the motivation for participating in continuing education was highly utilitarian, with the vast majority viewing it as a basic requirement for career advancement and professional registration, while lacking intrinsic motivation to learn. Only among the high-level title group (chief nurses) did personal interest account for a relatively high proportion. Secondly, learning time was scarce, as most nurses in the Emergency/ICU departments reported being too busy with work to engage in learning. Additionally, many nurses indicated experiencing certain financial burdens and had doubts about the quality of the learning content. Finally, the channels for obtaining credits were limited, with online learning being the dominant method, but with varying quality. Opportunities for external training and participation in research were scarce, making it difficult to meet the diverse learning needs of nursing staff.

Table 5. Survey results of the target group

Item	Category	Number of personnel	Percentage (%)
Level of policy awareness	Very aware / Aware	81	89.01
	Neutral / Not very aware	10	10.99
Motivation for continuing education participation	Promotion of a professional title	84	92.31
	License registration	54	59.34
	Skill improvement	50	54.95
	Personal interest	13	14.29
Main difficulties in continuing education	Too busy with work, no time	75	82.42
	High course fees	41	45.05
	Complex application process	22	24.18
	Dull and useless content	18	19.78
Ways to obtain credits	Remote online platform	86	94.51
	Academic conferences	70	76.92
	In-hospital training	64	70.33
	Offsite advanced study	29	31.87

(4) External environment

This study conducted a survey on the policy implementation in the external environment from three aspects: the convenience of online platforms, the intensity of the academic atmosphere, and the level of external support. The results are shown in **Table 6**. The overall convenience of online learning platforms is good, and the academic atmosphere for nursing in our hospital is also relatively strong. However, there

are still factors in the external environment that constrain policy implementation. Firstly, although the user experience of online platforms is generally good, there is a widespread lack of interactivity and practicality, which affects learning outcomes. Secondly, the absence of a regular academic exchange mechanism makes it difficult to sustain learning motivation. Lastly, although the overall support from families and society for nurses to participate in continuing education is relatively high, some nurses still have reduced willingness to learn due to reasons such as the economic downturn and high course fees. Therefore, economic burden has become an important external factor constraining the participation of nurses in continuing education.

Table 6. Survey results of the external environment

Item	Category	Number of participants	Percentage (%)
Convenience of online platform operation	Very convenient / Convenient	82	90.11
	Moderate	9	9.89
Nursing academic atmosphere	Very strong / Strong	78	85.71
	Moderate	13	14.29
External environmental support	Supportive / Relatively supportive	70	76.92
	Moderate / Not very supportive	21	23.08

4. Optimization strategies for the implementation of nursing continuing education policies based on the Smith model

4.1. Implement hierarchical and categorized credit management and curriculum systems

In response to the characteristics and needs of different groups, a flexible, hierarchical, and categorized credit system should be established [4]. For example, for nursing staff with low seniority and low educational qualifications, credit requirements should be appropriately reduced, with an increased emphasis on credits for basic theory and skill training. For nursing staff with high professional titles, credit requirements should be raised, with a greater focus on credits for research, teaching, and management ability training. For nursing staff in high-intensity departments, differentiated credit reductions should be implemented to alleviate their learning burden. Simultaneously, a "clinical demand-oriented" curriculum development mechanism should be established, involving frontline clinical nursing experts in curriculum design and teaching to ensure the integration of course content with clinical practice.

4.2. Optimize resource allocation and improve incentive mechanisms

Firstly, a specialty-resource matching database should be established to precisely allocate learning resources based on the learning needs of nurses in different departments. Collaboration with superior hospitals, universities, and research institutions should be strengthened to introduce high-quality educational resources [5]. Secondly, continuing education credits should be linked to salary, professional title promotion, job appointments, and merit evaluations to establish an integrated incentive mechanism that combines credits, abilities, and salaries, encouraging and assisting nursing staff in various departments to engage in continuing education learning activities.

4.3. Alleviate learning barriers and stimulate intrinsic motivation

It is recommended to adopt a blended online-offline teaching approach and promote a fragmented learning

model to minimize time conflicts between nursing work and learning. Special subsidies for continuing education should be established to increase the availability of free or low-cost continuing education courses, with priority given to opening in-house training and online learning resources [6]. Simultaneously, a learning organization culture should be cultivated to create a strong academic atmosphere, encouraging nurses to take the initiative to learn and communicate with each other. Education on professional identity should be strengthened to promote the value and significance of the nursing profession and alleviate occupational burnout among nurses.

4.4. Strengthen internal organizational support and resource integration

Hospitals should be encouraged to establish flexible work schedules to provide time guarantees for nursing staff to learn and enhance humanistic care for them, helping to resolve practical difficulties in their work and personal lives. Family support and psychological counseling should be provided to nurses in need [7]. The participation enthusiasm of governments, hospitals, universities, and society should be promoted to establish a multi-party collaborative nursing continuing education system. By integrating resources from various parties, social forces should be encouraged to participate in nursing continuing education, thereby providing more learning options for nursing continuing education.

5. Conclusion

In summary, based on the analysis using the Smith Model, this study finds that the challenges in implementing nursing continuing education policies primarily lie in the application of actual policies, resource allocation, and objective constraints such as personnel scheduling and economic burdens. During the actual implementation of policies, sustainability and personalization principles should be followed to maximize the improvement of in-house nursing continuing education policies.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhang F, Wang Z, Li J, et al., 2025, Current Situation and Reflections on the Development of Teaching in Traditional Chinese Medicine Nursing Continuing Education. Sichuan Journal of Traditional Chinese Medicine, 43(12): 173–182.

[2] Gao X, 2024, Research on the Causes of Blockage and Pathways to Resolution in the Implementation of Higher Continuing Education Policies: An Analysis Based on the Smith Policy Implementation Process Model. Adult Education, 44(12): 1–8.

[3] Wu S, Xi B, 2023, Research on the Constraints and Optimization Pathways of Continuing Medical Education Policy Implementation for General Practitioners in China. Chinese Journal of General Practice, 21(12): 1995–1999.

[4] Wang L, Li R, 2022, Exploration of the Cultivation of Nursing Continuing Education Concepts in the Context of Lifelong Education. China Continuing Medical Education, 14(22): 183–187.

[5] Lu X, Liang W, Zheng J, et al., 2025, Analysis of Research Hotspots in Nursing Academic Continuing Education in China Based on CiteSpace. Health Vocational Education, 43(1): 91–95.

[6] Di H, Liu L, Wang X, et al., 2024, Discussion on the Current Situation and Development Directions of Continuing Education for Specialist Nurses. Chinese Journal of Healthcare Management Science, 14(1): 87–92.

[7] Qin Y, 2025, Visual Analysis of Research on the Cultivation of Traditional Chinese Medicine Nursing Talents in China Over the Past 20 Years Based on CiteSpace. Health Vocational Education, 43(21): 115–120.

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Effects of Early Pulmonary Rehabilitation Training on Ventilator-Induced Diaphragmatic Dysfunction in ICU Mechanically Ventilated Patients: A Randomized Controlled Trial

Baoyi Yang[1], Na Wang[2]*, Rong Wang[1], Qi Tang[1]

[1]Department of Critical Care Medicine, Taihe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China
[2]Department of Nursing, Taihe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China

Author to whom correspondence should be addressed.

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Abstract: *Objective*: To investigate the preventive effects of early pulmonary rehabilitation training on ventilator-induced diaphragmatic dysfunction (VIDD) in ICU mechanically ventilated patients and its impact on clinical outcomes. *Methods*: A prospective randomized controlled trial was conducted. A total of 82 mechanically ventilated patients admitted to the intensive care unit of a tertiary hospital from January 2025 to December 2025 were enrolled and randomly assigned to either the experimental group (n = 41) or the control group (n = 41) using a random number table. The control group received routine ICU care and an early mobilization protocol, while the experimental group received systematic early pulmonary rehabilitation training in addition to the control protocol. Ultimately, 75 patients completed the study. Diaphragm excursion (DE), diaphragmatic thickening fraction (DTF), maximum inspiratory pressure (MIP), duration of mechanical ventilation, ICU length of stay, incidence of VIDD, and adverse events were compared between the two groups. *Results*: On day 5 and day 7 of the intervention, DE and DTF in the experimental group were significantly higher than those in the control group ($p < 0.05$). MIP on day 7 was significantly higher in the experimental group than in the control group ($p < 0.001$). The experimental group had significantly shorter durations of mechanical ventilation (6.2 ± 2.1 days vs. 8.7 ± 3.4 days) and ICU stays (9.5 ± 3.2 days vs. 12.8 ± 4.6 days) compared to the control group ($p < 0.001$). The incidence of VIDD was significantly lower in the experimental group (15.8%, 6/38) than in the control group (40.5%, 15/37; $p = 0.017$). No significant difference was found in the incidence of adverse events between the two groups ($p > 0.05$). *Conclusion*: Early pulmonary rehabilitation training effectively improves diaphragmatic function, reduces the incidence of VIDD, shortens the duration of mechanical ventilation and ICU length of stay in mechanically ventilated patients, and demonstrates good safety.

Keywords: Pulmonary rehabilitation; Mechanical ventilation; Ventilator-induced diaphragmatic dysfunction; Diaphragmatic ultrasound; Intensive care

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1. Introduction

Mechanical ventilation (MV) is a core life-support technology in intensive care units (ICUs), with approximately 30–88% of critically ill patients requiring MV. However, while MV saves lives, it places the diaphragm in a partial or complete unloading state, leading to decreased diaphragmatic tension, muscle fiber atrophy, and contractile dysfunction, known as ventilator-induced diaphragmatic dysfunction (VIDD) [1]. Studies indicate that the incidence of VIDD ranges from 60% to 80%, and 33% of patients with VIDD fail to recover diaphragmatic function after rehabilitation fully [2]. Evidence has confirmed that diaphragmatic atrophy and functional decline can occur within 24 hours after the initiation of MV, with atrophy progressing faster than in other skeletal muscles [3].

The pathophysiology of VIDD is complex, involving multiple molecular pathways such as mitochondrial oxidative stress, excessive activation of the ubiquitin-proteasome pathway, calpain and caspase-3-mediated proteolysis, and inhibition of protein synthesis [1,3]. VIDD not only severely affects the recovery of respiratory function but also leads to weaning difficulties, prolonged MV, extended ICU stays, increased medical costs, and even higher mortality [4]. Therefore, finding effective intervention strategies to prevent and improve VIDD has become a research hotspot in the field of critical care rehabilitation.

In recent years, pulmonary rehabilitation (PR), as a comprehensive non-pharmacological intervention, has received widespread attention for its application in ICU mechanically ventilated patients [5]. Studies have shown that early rehabilitation, including physical therapy, breathing training, and exercise training, can effectively prevent and improve respiratory muscle atrophy, enhance muscle strength, reduce in-hospital mortality, and improve overall prognosis [6–8]. However, high-quality randomized controlled trials focusing on the preventive effects of early pulmonary rehabilitation centered on respiratory muscle training for VIDD remain limited, particularly in the ICU setting in China. Therefore, this prospective randomized controlled trial aims to investigate the protective effects of early pulmonary rehabilitation training on diaphragmatic function and its impact on clinical outcomes in ICU mechanically ventilated patients, providing evidence-based support for critical care nursing practice.

2. Methods

2.1. Participants

This prospective randomized controlled trial was conducted in the ICU of a tertiary hospital from January 2025 to December 2025.

2.1.1. Inclusion criteria

(1) Age ≥ 18 years;
(2) Undergoing invasive MV via orotracheal intubation or tracheostomy;
(3) Expected duration of MV ≥ 72 hours;
(4) Relatively stable hemodynamics upon ICU admission (mean arterial pressure ≥ 65 mmHg);
(5) Informed consent provided by the patient or a family member.

2.1.2. Exclusion criteria

(1) History of neuromuscular disease or diaphragmatic paralysis before ICU admission;
(2) Previous diaphragmatic surgery;

(3) Conditions unsuitable for respiratory rehabilitation (e.g., cervical spine fracture, intracranial hypertension);
(4) Severe hemodynamic instability requiring high-dose vasoactive agents;
(5) Pregnancy;
(6) Terminal illness with expected survival < 6 months.

2.1.3. Elimination criteria

(1) MV duration < 72 hours due to extubation or death;
(2) Transfer out of the ICU during the study period;
(3) Withdrawal of informed consent.

2.1.4. Sample size calculation

Using PASS 15.0, based on pre-trial results (VIDD incidence of approximately 18% in the experimental group and 42% in the control group), with $\alpha = 0.05$ (two-tailed), power $1-\beta = 0.80$, a 1:1 allocation, and accounting for a 15% dropout rate, 82 patients were required. A random number table generated by SPSS 26.0 was used by a statistician not involved in the intervention to randomly assign 82 patients to the experimental group (n = 41) and control group (n = 41). Allocation concealment was achieved using sealed envelopes. The study was approved by the hospital ethics committee (approval number: XM2025115).

2.2. Interventions

2.2.1. Control group

The control group received routine ICU care and an early mobilization protocol, including:
(1) Basic care (vital sign monitoring, airway management, oral care);
(2) Passive/active range of motion exercises (twice daily, 15–20 min each) based on consciousness and muscle strength;
(3) Head-of-bed elevation to 30–45°;
(4) Suctioning as needed;
(5) Minimal sedation strategy.

2.2.2. Experimental group

In addition to the control protocol, the experimental group received a 7-day systematic early pulmonary rehabilitation training program delivered by a trained critical care rehabilitation team (including one ICU head nurse, two ICU specialist nurses, and one respiratory therapist). All team members completed a 2-week standardized training program and passed assessments covering bedside diaphragmatic ultrasound, respiratory muscle training techniques, airway clearance techniques, early mobilization protocols, and safety monitoring.

(1) Bedside diaphragmatic ultrasound and individualized plan

Within 24 hours of enrollment, a nurse trained in diaphragmatic ultrasound assessed baseline diaphragmatic function using a bedside ultrasound system (convex probe 2–5 MHz; linear probe 7–12 MHz), measuring DE and DTF. Based on the results, along with the patient's consciousness level (RASS score), Medical Research Council score (MRC-Score), and hemodynamic status, the rehabilitation team developed an individualized pulmonary rehabilitation plan specifying training methods, intensity, frequency, and

progression criteria.

(2) Progressive respiratory muscle training

Passive stimulation phase (for RASS -3 to -1 or unable to cooperate): Patients in semi-recumbent position (head-of-bed 30–45°) received passive respiratory muscle stimulation by adjusting ventilator trigger sensitivity (initial setting -3 cmH_2O, decreased by 0.5–1 cmH_2O every 24 hours to a target of -1 cmH_2O, twice daily, 15 min each) [9,10].

(3) Active training phase (for RASS -1 to +1 able to follow commands)

Included diaphragmatic breathing, deep breathing exercises, and threshold inspiratory muscle training (initial load at 30% of MIP, 10–15 breaths per session, twice daily, with load increased by 5–10% weekly up to 50% of MIP, Borg dyspnea score ≤5) [11–13]. Each session lasted 15–20 minutes with at least 4 hours between sessions.

(4) Effective coughing and airway clearance training

For conscious patients (RASS -1 to +1) able to follow commands: effective coughing training (deep inspiration – 2-second breath hold – forceful cough) and active cycle of breathing technique (ACBT) [14,15]. Manual chest compression was applied if needed.

(5) Early progressive positioning management

Daily positioning level determined by the ICU mobility scale (IMS): IMS 0–1: passive repositioning and range of motion; IMS 2–3: additional semi-recumbent active maintenance; IMS 4–5: transition to sitting at the bedside; IMS 6–7: standing or sitting in a chair [16].

(6) Dynamic diaphragmatic ultrasound monitoring and adjustment

DE and DTF were assessed at days 1, 3, 5, and 7 by the same trained nurse. Training intensity was adjusted based on diaphragmatic function trends (increase load if DTF improved by ≥ 5%; maintain if DTF decreased by ≥ 10% or no improvement; initiate enhanced stimulation if DTF < 20% for > 72 hours).

(7) Safety stopping criteria

Training was immediately stopped if any of the following occurred: heart rate > 140/min or < 40/min; new arrhythmias; systolic blood pressure >180 mmHg or <85 mmHg, or fluctuation > 20% from baseline; SpO_2 < 88% or > 5% drop from baseline; respiratory rate > 35/min; or overt patient intolerance.

2.3. Outcome measures

2.3.1. Primary outcome

VIDD incidence, defined as DTF < 20% combined with DE < 10 mm (during quiet breathing), was assessed on day 7 [14].

2.3.2. Secondary outcomes

(1) Diaphragmatic ultrasound parameters (DE and DTF) measured on days 1, 3, 5, and 7 [9].

(2) Maximum inspiratory pressure (MIP) measured on days 1 and 7 [4].

(3) Clinical outcomes: duration of mechanical ventilation (from intubation to successful extubation with spontaneous breathing ≥ 48 hours) and ICU length of stay.

(4) Adverse events

unplanned extubation, catheter displacement, falls, severe arrhythmias, and marked blood pressure fluctuations.

2.4. Statistical analysis

SPSS 26.0 was used. The per-protocol (PP) set was used for primary efficacy analysis. Normally distributed continuous data were expressed as mean ± standard deviation ($\overline{x} \pm s$) and compared using an independent samples *t*-test or repeated measures ANOVA. Non-normally distributed data were expressed as median (IQR) and compared using the Mann-Whitney U test. Categorical data were expressed as frequencies and percentages and compared using the χ^2 test or Fisher's exact test. $p < 0.05$ was considered statistically significant.

3. Results

3.1. Baseline characteristics

Of the 82 enrolled patients, 75 completed the study (38 in the experimental group, 37 in the control group). No significant differences were found between the two groups in age, sex, BMI, APACHE II score, primary diagnosis, or PaO_2/FiO_2 ratio at ICU admission ($p > 0.05$), indicating comparability.

3.2. Diaphragmatic ultrasound indicators

On days 5 and 7, DE and DTF in the experimental group were significantly higher than those in the control group ($p < 0.05$). Repeated measures ANOVA showed significant time, group, and interaction effects for both DE and DTF ($p < 0.001$) (**Table 1**).

Table 1. Comparison of DE and DTF between the two groups ($\overline{x} \pm s$)

Parameter	Group	Day 1	Day 3	Day 5	Day 7	F-time	F-group	F-interaction
DE (mm)	Experimental	13.8 ± 2.8	14.2 ± 3.1	15.9 ± 3.4	17.1 ± 3.2	42.158	8.952	12.346
	Control	14.1 ± 3.0	13.5 ± 3.2	13.2 ± 3.5	13.4 ± 3.6			
DTF (%)	Experimental	28.5 ± 6.2	27.8 ± 5.9	31.2 ± 7.1	34.6 ± 7.8	36.724	10.158	15.637
	Control	29.1 ± 6.5	26.4 ± 6.3	24.8 ± 6.8	23.5 ± 7.2			

3.3. Maximum inspiratory pressure (MIP)

On day 7, MIP in the experimental group was significantly higher than that in the control group and significantly improved from day 1 ($p < 0.001$), while no significant change was observed in the control group ($p > 0.05$) (**Table 2**).

Table 2. Comparison of MIP between the two groups (cmH_2O, $\overline{x} \pm s$)

Group	**Day 1**	**Day 7**	***t***	*p*
Experimental	38.6 ± 8.4	52.4 ± 9.7	-8.432	< 0.001
Control	39.2 ± 9.1	36.5 ± 8.8	1.856	0.068
t	-0.298	7.456		
p	0.766	< 0.001		

3.4. Clinical outcomes and VIDD incidence

The experimental group had significantly shorter duration of MV (6.2 ± 2.1 vs. 8.7 ± 3.4 days, $p < 0.001$) and ICU length of stay (9.5 ± 3.2 vs. 12.8 ± 4.6 days, $p < 0.001$). VIDD incidence was significantly lower in the

experimental group (15.8% vs. 40.5%, $p = 0.017$) (**Table 3**).

Table 3. Comparison of clinical outcomes between the two groups

Outcome	Experimental (n = 38)	Control (n = 37)	t/χ^2	p
MV duration (days, $\overline{x} \pm s$)	6.2 ± 2.1	8.7 ± 3.4	-3.978 *	< 0.001
ICU LOS (days, $\overline{x} \pm s$)	9.5 ± 3.2	12.8 ± 4.6	-3.756 *	< 0.001
VIDD [n (%)]	6 (15.8)	15 (40.5)	5.70 △	0.017

3.5. Adverse events

In the experimental group, transient blood pressure fluctuations (3 cases, 7.9%) and tachycardia (2 cases, 5.3%) occurred, all resolving after pausing or reducing training intensity. No severe adverse events (unplanned extubation, catheter displacement, falls) occurred. No significant difference in total adverse events was found between the two groups ($p = 0.673$).

4. Discussion

This study demonstrates that early pulmonary rehabilitation training effectively protects diaphragmatic function in ICU mechanically ventilated patients, as evidenced by significantly higher DE and DTF in the experimental group compared to the control group ($p < 0.05$). These findings are consistent with previous studies showing that early pulmonary rehabilitation combined with bundled nursing care improves diaphragmatic excursion [6] and that inspiratory muscle training significantly enhances diaphragmatic excursion in mechanically ventilated patients [2,4]. Notably, diaphragmatic function in the control group progressively declined on days 5 and 7, confirming the pathophysiological effect of MV-induced diaphragmatic unloading and atrophy [1,3]. In contrast, the experimental group showed no decline but rather an improvement in diaphragmatic function, suggesting that early pulmonary rehabilitation effectively counteracts the adverse effects of MV on the diaphragm [17].

The VIDD incidence in the experimental group (15.8%) was significantly lower than that in the control group (40.5%), and both MV duration and ICU length of stay were significantly shortened. Given that reported VIDD incidence can reach 60–80%, and VIDD-related weaning difficulties increase complications, costs, and mortality [1,2,4], the comprehensive and phased nature of our intervention, integrating respiratory muscle training, airway clearance techniques, and early progressive positioning with ultrasound-based dynamic adjustment, likely contributed to its success. This reflects a closed-loop management concept of "assessment–intervention–reassessment" [18].

Safety is a primary concern when implementing early rehabilitation in ICU patients with critical illness, multiple catheters, and hemodynamic instability [19,20]. Consistent with prior studies, the experimental group in our study experienced only minor, transient adverse events (blood pressure fluctuations, tachycardia) that resolved quickly, with no increase in serious adverse events compared to the control group [4,5]. These results confirm that early pulmonary rehabilitation training can be safely implemented in ICU mechanically ventilated patients under close monitoring and standardized management.

5. Conclusion

Early pulmonary rehabilitation training effectively improves diaphragmatic function, reduces the incidence of VIDD, shortens the duration of mechanical ventilation and ICU length of stay in ICU mechanically ventilated patients, and demonstrates good safety. This study recommend that individualized early pulmonary rehabilitation training based on bedside ultrasound assessment be routinely implemented for mechanically ventilated patients in ICU clinical nursing practice to protect diaphragmatic function and improve patient outcomes.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Fu W, Guan L, Liu Q, et al., 2025, Ventilator-Induced Diaphragmatic Dysfunction: Pathophysiology, Monitoring, and Advances in Potential Treatment and Prevention. European Respiratory Review, 34(178): 250069.

[2] Benli R, Yurdalan U, Yılmaz B, et al., 2024, Effect of Post-Extubation Inspiratory Muscle Training on Diaphragmatic Function in Mechanically Ventilated Patients: A Randomized Controlled Trial. Advances in Clinical and Experimental Medicine, 33(10): 1077–1085.

[3] Khwaja S, Habib M, Gupta R, et al., 2025, Unraveling Ventilator-Induced Diaphragmatic Dysfunction: A Comprehensive Narrative Review on Pathogenesis, Diagnosis, and Management. Current Respiratory Medicine Reviews, 21(1): 1–15.

[4] Wang S, Chen Y, Lin S, et al., 2025, Inspiratory Muscle Training Facilitates Liberation from Mechanical Ventilation in Subacute Critically Ill Patients: A Randomized Controlled Trial. Frontiers in Medicine, 11: 1503678.

[5] Farley C, Newman A, Ho J, et al., 2025, The Effects of Inspiratory Muscle Training in Critically Ill Adults: A Systematic Review and Meta-Analysis. Journal of Intensive Care Medicine, 40(3): 238–252.

[6] Liu H, Ni P, Li L, et al., 2024, Effect of Early Pulmonary Rehabilitation Combined with ESCAPE Bundled Nursing on Ventilator-Induced Diaphragmatic Dysfunction in ICU Patients Undergoing Invasive Mechanical Ventilation. Qilu Journal of Nursing, 30(10): 23–27.

[7] Wang J, Li S, Zhang Y, et al., 2025, Relationship Between Mechanical Ventilation Duration and Diaphragmatic Function Recovery Under Integrated Rehabilitation Intervention. Chinese Journal of Integrated Traditional and Western Medicine Surgery, 31(1): 50–55.

[8] Hao T, Cheng J, Li Q, et al., 2025, Effect of Phrenic Nerve Electrical Stimulation on Extubation Outcomes in ICU Mechanically Ventilated Patients: A Meta-Analysis. Chinese Journal of Respiratory and Critical Care Medicine, 24(1): 9–17.

[9] Chen L, Zhao M, Sun T, et al., 2025, Effect of Early Out-of-Bed Activity on Diaphragmatic Function in ICU Mechanically Ventilated Patients. Chinese Journal of Nursing, 60(4): 456–462.

[10] Lin X, Zhang M, Huang L, et al., 2024, Effect of Respiratory Muscle Training Combined with Lung Ultrasound Monitoring on Diaphragmatic Function and Weaning in Mechanically Ventilated Patients. Contemporary Nurse (First Issue), 31(3): 42–46.

[11] Critical Care Rehabilitation Committee of the Chinese Rehabilitation Medical Association, 2025, Chinese Expert Consensus on Severe-Subacute Organ Rehabilitation – Pulmonary Rehabilitation Section. Chinese Journal of Rehabilitation Medicine, 40(7): 1–15.

[12] Zhou W, Li S, He P, et al., 2025, Summary of Best Evidence for Diaphragmatic Rehabilitation in ICU Mechanically Ventilated Patients. Chongqing Medicine, 54(6): 1–6.

[13] Tong S, Yang Y, Li Y, et al., 2025, Consequences in Critically Ill Patients with Prolonged Mechanical Ventilation After Diaphragmatic Stimulation Techniques: A Systematic Review and Meta-Analysis. Intensive and Critical Care Nursing, 86: 103789.

[14] Dres M, Goligher E, Heunks L, et al., 2025, Monitoring and Preserving Diaphragmatic Function in Critically Ill Patients. Current Opinion in Critical Care, 31(2): 132–141.

[15] He L, Zhou P, Zheng H, et al., 2025, Research Progress on Diaphragmatic Rehabilitation in Critically Ill, Mechanically Ventilated Patients. Chinese Journal of Nursing, 60(14): 1785–1791.

[16] Ma J, Yang L, Han B, 2025, Monitoring and Rehabilitation of Diaphragmatic Dysfunction in Mechanically Ventilated Patients. Proceedings of the First Symposium on Clinical Medicine Application Development and Integrated Medical and Nursing Care: 15–20.

[17] Li T, Zhang W, Xu J, et al., 2025, Effect of MDT-Assisted Early Graded Respiratory Rehabilitation Training on Respiration, Oxygenation, DE, and DTF in Mechanically Ventilated Patients. Nursing Research, 39(3): 510–515.

[18] Rochester C, Singh S, Spruit M, et al., 2025, Respiratory Muscle Dysfunction in Older Critically Ill Patients: Implications for Rehabilitation. Critical Care Clinics, 41(4): 671–686.

[19] Mitchell R, Davies A, Chen L, 2026, Rehabilitating the Diaphragm: An Integrated Approach to Intensive Care Unit-Acquired Dysfunction in Critical Illness: A Narrative Review. Annals of Clinical Care and Critical Care, 5(1): 25–36.

[20] Zhang L, Wang F, Liu C, et al., 2025, Summary of Best Evidence for Diaphragmatic Function Training in Mechanically Ventilated Patients. Chinese Nursing Management, 25(8): 1275–1282.

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Regulatory Effect of Integrated Body Temperature Optimization Protocol on the Rehabilitation Process during the Perioperative Period of Transurethral Resection of the Prostate (TURP)

Ping Lu

Xinghua People's Hospital, Kangda College of Nanjing Medical University, Taizhou 225700, Jiangsu, China

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Abstract: *Objective:* To analyze the effect of implementing an integrated body temperature optimization protocol on patients during transurethral resection of the prostate (TURP). *Methods:* This study employed a randomized controlled trial design, selecting 102 patients who underwent TURP treatment from September 2024 to August 2025. Patients were randomly assigned using a computer-generated random number table, with an equal number in each group (n = 51). The control group received conventional perioperative care, while the experimental group implemented an integrated body temperature optimization protocol. The postoperative recovery status and the incidence of shivering or hypothermia were used as evaluation criteria to assess the clinical impact of different care protocols on patient rehabilitation. *Results:* Patients in the experimental group were able to ambulate and pass gas sooner after surgery, and the total duration of continuous bladder irrigation was significantly shorter than that in the control group ($p < 0.05$). Additionally, the incidence rates of various indicators, such as shivering severity, hypothermia, and complication rates, were lower in the experimental group compared to the control group ($p < 0.05$). *Conclusion:* For TURP patients, especially the elderly, an integrated body temperature optimization protocol can effectively reduce the incidence of shivering and promote rehabilitation.

Keywords: Integrated body temperature optimization protocol; Transurethral resection of the prostate; Body temperature care

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1. Introduction

TURP is a classic surgical method for treating benign prostatic hyperplasia (BPH) in older people, with its efficacy and safety widely validated. This procedure effectively relieves urethral obstruction and improves

lower urinary tract symptoms in most patients, such as frequent urination, urgency, nocturia, and dysuria, while increasing urinary flow rate [1]. Guided by the Enhanced Recovery After Surgery (ERAS) concept, the integrated body temperature optimization protocol involves multidisciplinary collaboration in perioperative interventions based on evidence-based medicine. Its core is to alleviate the stress response caused by surgery and promote rapid recovery through a series of scientific measures. By implementing closed-loop management of preoperative pre-warming, intraoperative active warming, and postoperative continuous monitoring, it effectively addresses the issue of heat loss during the perioperative period, particularly benefiting high-risk patients such as the elderly and those undergoing prolonged surgeries. In recent years, studies have gradually combined these two approaches in the treatment of elderly TURP patients, yielding promising clinical data. This article aims to validate the above conclusions through a randomized controlled trial, hoping to provide references for future research in this direction.

2. Materials and methods

2.1. General information

A total of 102 elderly BPH patients were included in the study, receiving treatment at the hospital from September 2024 to August 2025. They were randomly assigned to the control group and the experimental group using a computer-generated random number table, with 51 patients in each group. The basic information of the two groups is as follows: in terms of age, the mean age in the control group was (73.68 ± 5.04) years, while in the experimental group, it was (74.13 ± 5.28) years. Regarding the duration of illness, the control group had an average of (4.63 ± 1.08) months, and the experimental group had (4.82 ± 1.03) months. The general information between the two groups showed $p > 0.05$.

2.2. Methods

2.2.1. Control group

Conventional perioperative care for surgical treatment included:

(1) Formation of a nursing team

The head nurse was responsible for personnel coordination, reporting patient conditions, and inspecting nursing work, while nurses were responsible for connecting with other departments and carrying out standardized and procedural nursing operations collaboratively.

(2) Preoperative care

Nurses needed to visit the ward regularly to grasp the patient's basic condition and strengthen coordination with ward nurses. They were required to prepare all necessary surgical supplies, assist in positioning the patient, and implement warming measures.

(3) Intraoperative care

Minimize skin exposure of the patient. Nurses also needed to closely cooperate with the doctor, understand the surgical procedure and the doctor's working habits, and quickly pass the required instruments to the doctor.

(4) Postoperative care

Nurses needed to wipe the patient's skin with warm water, help the patient dress, provide a warming blanket to improve body temperature, observe the placement of the drainage tube and the color and properties of the drainage fluid, coordinate work with relevant departments, properly handle tube fixation, and inform

the patient and their family of postoperative precautions.

2.2.2. Experimental group

Implementation of an integrated body temperature optimization protocol with specific operations as follows:

(1) Preoperative phase

a. Baseline body temperature assessment and risk screening: Monitor the patient's axillary or oral temperature 24 hours before surgery, with a focus on high-risk groups for hypothermia, such as elderly patients, those with comorbid diabetes, malnutrition, or long-term use of sedative drugs, and establish a body temperature file. b. Preoperative diet and fluid management: Shorten the fasting and fluid restriction time according to ERAS requirements, specifically prohibiting solid food intake 6 hours before surgery and allowing oral intake of warm carbohydrate drinks, such as warm water containing glucose, 2 hours before surgery to prevent energy deficiency and decreased thermoregulatory capacity due to prolonged fasting.

(2) Intraoperative phase

a. Irrigation fluid warming and constant temperature control: Continuous irrigation of the surgical field with irrigation fluid is required during the operation, with a volume of several liters. Using room-temperature irrigation fluid can lead to significant heat loss, so it is necessary to warm the irrigation fluid to 37–38 ℃ using a dedicated warming device and deliver it through a constant-temperature infusion line to reduce heat loss caused by the temperature difference between the irrigation fluid and the body. b. Body surface and environmental warming: Maintain the operating room temperature at 25–26 ℃ and avoid direct cold air blowing on the patient. Cover the non-surgical areas of the patient's trunk and lower limbs with a warm air blanket, with the temperature adjusted to 38–40 ℃, exposing only the perineal surgical area. Wrap the limbs with warming socks to reduce peripheral heat dissipation. Use a 37 ℃ warmer for intravenous infusion or blood transfusion to avoid a decrease in body temperature caused by cold fluid infusion.

(3) Postoperative phase

a. Monitoring body temperature during the recovery period: Monitor the patient's axillary or forehead temperature every 30 minutes after returning to the ward or the anesthesia recovery room for 24 hours until the body temperature stabilizes above 36 ℃. Promptly address any body temperature below 36 ℃ or shivering. b. Stepwise warming intervention: For mild hypothermia (35.5–36 ℃), provide additional warming blankets and use a 36–37 ℃ constant-temperature blanket to avoid overheating and sweating. For moderate hypothermia (35–35.5 ℃), in addition to body surface warming, supplement heat by nasogastric or oral administration of 37–38 ℃ warm saline, while avoiding rapid warming-induced vasodilation. Do not use local high-temperature devices such as hot water bottles.

2.3. Observation indicators

(1) Record the postoperative recovery status of the patients.

(2) Shivering severity

Evaluate the shivering severity of patients in both groups using the Wrench grading scale for shivering, ranging from grade 0 to grade 4.

(3) Observe whether the two groups develop complications such as wound infection, nausea and vomiting, arrhythmia, muscle soreness, headache, and respiratory depression, as well as hypothermia events.

2.4. Statistical methods

Clinical validation of the research data was conducted using unified SPSS 25.0 software. Normally distributed measurement data were expressed as ($\overline{x} \pm s$), and the t-test was performed. Count data (n%) were used to calculate the χ^2 value using standard methods. A difference was considered statistically significant when $p < 0.05$.

3. Results

3.1. Postoperative indicators in both groups

As shown in **Table 1** below, patients in the experimental group were able to ambulate and pass gas significantly sooner after surgery, and the duration of continuous bladder irrigation was shorter compared to the control group ($p < 0.05$).

Table 1. Analysis of postoperative recovery status in both groups of patients

Group	Number of cases	Ambulation time (d)	Time to first flatus (h)	Duration of continuous bladder irrigation (d)
Experimental group	51	1.28 ± 0.39	14.87 ± 3.14	1.80 ± 0.37
Control group	51	3.48 ± 0.46	28.71 ± 4.52	3.65 ± 0.61
t		26.051	17.958	18.518
p		0.000	0.000	0.000

3.2. Incidence of shivering in both groups

Table 2 shows that the probability of Grade 0 shivering in the experimental group was higher than that in the control group, with $p < 0.05$. The incidences of other grades were relatively lower or absent, but without statistical significance, $p > 0.05$.

Table 2. Comparison of shivering severity between the two groups (n%)

Group	Number of cases	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Experimental group	51	40 (78.4)	8 (15.7)	3 (5.9)	0 (0.0)	0
Control group	51	29 (56.9)	15 (29.4)	5 (9.8)	2 (3.9)	0
χ^2		5.420	2.750	0.542	2.040	-
p		0.019	0.097	0.461	0.153	-

3.3. Statistics on complications and hypothermia

Upon reviewing Statistical **Table 3**, it was found that both categories of data were lower in the experimental group, with a *p*-value of less than 0.05 between the groups.

Table 3. Comparison of complication rates and hypothermia rates between the two groups (n%)

Group	Number of cases	Wound infection	Nausea and vomiting	Arrhythmia	Muscle ache	Head ache	Respiratory depression	Total incidence of complications	Incidence of hypothermia
Experimental group	51	1	1	0	1	0	0	3 (5.9)	1 (12.0)
Control group	51	2	3	0	3	1	1	10 (19.6)	7 (13.7)

χ^2	4.319	4.883
p	0.037	0.027

4. Discussion

This study systematically evaluated the regulatory effects of an integrated body temperature optimization protocol on the perioperative rehabilitation process of elderly patients undergoing transurethral resection of the prostate (TURP) through a prospective randomized controlled trial involving 102 cases [2]. The data analysis results clearly demonstrated significant benefits of this systematic intervention strategy across multiple dimensions of clinical outcomes. In terms of early postoperative recovery indicators, patients in the experimental group who received the integrated body temperature optimization protocol exhibited a marked trend toward accelerated rehabilitation. The mean time to ambulation in the experimental group was 1.28 days, the mean time to first flatus was 14.87 hours, and the mean duration of continuous bladder irrigation was 1.80 days. These three core rehabilitation time-point indicators were significantly shorter than the corresponding values in the control group (3.48 days, 28.71 hours, and 3.65 days, respectively), with highly statistically significant differences between the groups. The simultaneous optimization of these three time indicators collectively delineated a steeper and more efficient postoperative recovery trajectory. This "upgrade" in recovery speed can be traced back to the physiological basis of maintaining body temperature stability, which sustains metabolic and homeostatic balance in the body. The maintenance of core body temperature avoids negative physiological effects such as coagulation dysfunction, slowed drug metabolism, and decreased tissue oxygen supply caused by hypothermia, creating optimal metabolic conditions for tissue repair, gastrointestinal motility recovery, and early mobilization of systemic functions [3,4].

The core objective of the body temperature optimization protocol, maintaining perioperative body temperature homeostasis, was robustly validated through direct comparison of the incidence rates of shivering and hypothermia. According to the Wrench grading scale, patients in the experimental group experienced significantly reduced postoperative shivering severity, with a 78.4% proportion of Grade 0 (no shivering), significantly higher than the 56.9% in the control group. Although the incidence rates of shivering Grades 1 to 4 did not show statistically significant differences between the groups, the absolute advantage in the proportion of Grade 0 cases fully indicated that the integrated protocol effectively prevented moderate to severe shivering. Shivering is a vigorous heat-producing reaction of the body in a cold environment, which itself consumes a large amount of energy, increases myocardial oxygen consumption, exacerbates pain and discomfort, and is an important source of postoperative stress [5]. The effective control of shivering incidence in the experimental group was the result of the synergistic effects of a series of measures, including preoperative pre-warming, active warming of irrigation fluid and body surface during surgery, and postoperative stepwise warming. More critically, the overall incidence of hypothermia in the experimental group was controlled at 2.0%, while it was as high as 13.7% in the control group, with a significant difference between the groups. Hypothermia, typically defined as a core body temperature below 36 ℃, has far-reaching harms, including but not limited to increasing the risk of surgical site infection, impairing immune function, affecting the coagulation cascade, and prolonging anesthesia recovery time. In this study, the experimental group constructed a three-dimensional "heat protection network" through closed-loop body temperature management, encompassing source control, pathway intervention, and monitoring, successfully

reducing the incidence of this severely disruptive homeostatic event to an extremely low level. The effective prevention of hypothermia served as the cornerstone for a series of subsequent favorable clinical outcomes [6].

The significant reduction in the incidence of complications was one of the most direct and clinically meaningful endpoint benefits derived from body temperature homeostasis. In this study, the overall postoperative complication rate in the experimental group was 5.9%, significantly lower than the 19.6% in the control group. The reduction in complications was the result of the synergistic effects of multiple factors, with body temperature optimization playing a pivotal role. First, maintaining normal body temperature is fundamental for preserving immune function. Hypothermia can inhibit the chemotaxis, phagocytosis, and killing functions of neutrophils, directly increasing the risk of surgical site infection [7]. The extremely low wound infection rate in the experimental group was closely related to this mechanism. Second, body temperature stability helps maintain normal coagulation function. Hypothermia can affect platelet function, prolong prothrombin time and partial thromboplastin time, and increase surgical field bleeding, which may not only prolong bladder irrigation time but also serve as a risk factor for deep vein thrombosis. The shorter bladder irrigation time in the experimental group indirectly confirmed better intraoperative hemostasis. Furthermore, complications such as nausea, vomiting, and arrhythmias are closely related to surgical stress, anesthesia drug metabolism, and autonomic nervous system dysfunction [8]. Body temperature stability provided a guarantee for a smooth anesthesia recovery period by reducing shivering reactions, lowering systemic stress levels, and maintaining more stable autonomic nervous system tone. Therefore, the low complication rate of 5.9% in the experimental group was not coincidental; it was a comprehensive outcome achieved by body temperature management, which protected immune, coagulation, neuroendocrine, and other systemic functions, constructing a solid “protective wall” for patients.

5. Conclusion

Based on the aforementioned data, the regulatory effects of the integrated body temperature optimization protocol on the perioperative rehabilitation process of TURP can be summarized as a physiological optimization process with “body temperature homeostasis” as the core regulatory target, generating systemic and positive cascade reactions through multi-link interventions [9]. This protocol transcends the fragmented and passive warming measures in traditional perioperative care, replacing them with an evidence-based, proactive, precise, and integrated management system that spans the preoperative, intraoperative, and postoperative periods. Its regulatory mechanisms are manifested at three levels: at the metabolic level, it ensures the optimal temperature range for enzyme activity by maintaining core body temperature, enabling efficient energy metabolism, protein synthesis, and drug biotransformation in the body, which provides the material and energy basis for tissue repair and gastrointestinal function recovery. At the circulatory and coagulation level, it avoids vasoconstriction, increased blood viscosity, and coagulation dysfunction caused by hypothermia, optimizing tissue perfusion, reducing surgical wound bleeding, and promoting hemostasis and healing [10]. At the neuroendocrine and immune level, it significantly reduces shivering reactions, lowers excessive stress activation of the hypothalamic-pituitary-adrenal axis, and maintains normal immune cell function, thereby reducing the overall intensity of surgical trauma to the body. This protocol is characterized by standardized operation, high cost-effectiveness, and safety without invasiveness, making it easily promotable in clinical settings.

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References

[1] Tao Y, Zhao Y, Wang L, et al., 2025, Application Value of Evidence-Based Body Temperature Management Combined with Modular Surgical Cooperation in the Nursing of Patients Undergoing Transurethral Resection of the Prostate. Chinese Journal of Human Sexuality, 34(4): 22–27.

[2] Liu Y, 2023, Analysis of the Effect of Comprehensive Thermal Insulation Nursing on Preventing Intraoperative Hypothermia in Patients Undergoing Transurethral Resection of the Prostate. Henan Journal of Surgery, 29(1): 189–191.

[3] Guo Y, 2022, Effect of Multi-Modal Thermal Insulation Nursing in the Operating Room on Preventing Intraoperative Hypothermia and Shivering in Patients Undergoing Transurethral Resection of the Prostate. Henan Journal of Surgery, 28(1): 183–185.

[4] Zhao Y, 2025, Analysis of the Nursing Intervention Effect on Preventing Intraoperative Hypothermia in Patients Undergoing Prostate Resection. Medical Forum, 7(20): 255–257.

[5] Zhao X, Liang L, Ma L, 2023, Application of Body Temperature Intervention Combined with Core Temperature Irrigation Fluid in Bladder Spasm in Patients Undergoing Transurethral Resection of the Prostate. General Nursing, 21(10): 1380–1382.

[6] Bao F, Song Q, Jin R, et al., 2023, Application of Comfort Theory-Based Body Temperature Management in Preventing Hypothermia in Patients Undergoing Transurethral Resection of the Prostate. Chinese Journal of Modern Nursing, 29(1): 93–97.

[7] Jiang B, Ye S, Diao X, 2023, Application of Comprehensive Operating Room Nursing in Preventing Intraoperative Hypothermia and Shivering in Elderly Patients Undergoing Prostate Surgery. Chinese Journal of Human Sexuality, 32(6): 52–56.

[8] Li W, Guo M, Yu J, et al., 2025, Application of Mind Mapping Combined with Early Warning Nursing in the Operating Room Nursing of Patients Undergoing Transurethral Resection of the Prostate. Chinese and English Journal of Integrated Traditional Chinese and Western Medicine Nursing, 11(9): 173–176.

[9] Li T, Zhang Y, He Y, et al., 2025, Application Effect of a Multidisciplinary Nursing Model in Anesthesia Recovery in Elderly Patients After Prostate Resection. Clinical Research and Practice, 10(30): 137–140.

[10] Li L, Leng M, 2024, Observation on the Application of Enhanced Recovery After Surgery Nursing Combined with Three-Stage Multi-Modal Thermal Insulation Nursing in Patients Undergoing Transurethral Resection of the Prostate. Reflexology and Rehabilitation Medicine, 5(23): 166–169.

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Information-Based Transformation of the Critical Value Management Process in the Clinical Laboratory

Chenkai Shi

Clinical Laboratory, Central Health Center of Sijia Town, Haimen District, Nantong 226141, Jiangsu, China

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Abstract: *Objective:* This study aims to analyze and research the entire process management of critical values from the clinical laboratory to clinicians, enhancing reminders and control through information technology and programming. *Methods:* The critical value management function was activated, and control management was inserted into the database through stored procedures. Views were created to push patient information via SMS platforms. *Conclusion:* Through optimization, the management process of critical values between the clinical laboratory and clinicians has been strengthened, preventing missed reporting and handling of critical values. A closed-loop management process for critical values has been achieved, improving the notification rate and timely handling rate of critical values, reducing clinical diagnosis and treatment risks, and demonstrating significant clinical application value.

Keywords: Critical values; Early warning function; Notification rate; Timeliness rate

Online publication: Jun 30, 2026

1. Introduction

Critical values refer to test results that significantly deviate from the normal reference range, indicating that the patient may be in a life-threatening condition. Clinicians need to receive this information promptly to provide effective interventions or treatments that could save the patient's life; otherwise, severe consequences may arise, and the best opportunity for rescue may be lost. Critical values are a crucial aspect of hospital diagnosis and treatment processes. With the development of information technology, the demand for computer software in medical services is increasing. To enhance the management level of critical values in our hospital and meet the requirements of graded hospital management for critical values, it is imperative to strengthen critical value reporting management through information technology. This study introduces the information technology methods used in the critical value management process in our hospital. By utilizing stored procedures and views in the database and flexibly applying them in the Laboratory Information System (LIS) and Hospital Information System (HIS), a closed-loop management process for critical

value reporting has been established [1]. This optimizes the critical value management pathway, strengthens reporting and handling times in the critical value management process, improves the notification rate and timeliness of critical values in our hospital, enhances medical quality, and ensures patient safety.

2. Current status of critical value management

The overall model for managing critical values in our hospital is currently outdated, with outdated methods still relying on traditional manual management. This primarily involves reporting critical test values via telephone, recording them on paper, and having clinicians receive and record critical value results over the phone. This approach is significantly out of sync with modern healthcare quality and safety management standards and the construction criteria for smart hospitals, making it difficult to meet the safety control requirements of modern clinical diagnosis and treatment. Currently, the reporting, notification, registration, and tracking of critical values in the clinical laboratory lack information-based management, with incomplete paper records [2]. There are no clinical handling recommendations, and the entire critical value process does not form a complete closed loop. Manual operations in critical value management are cumbersome and not rigorous, leading to potential omissions in reporting critical values, missed recordings by clinicians upon receiving them, and even instances where critical patient values are not addressed in a timely manner. During the critical value management process, it is impossible to monitor the notification rate and timeliness rate, and the cost of manual management is excessively high. To change this status quo, strengthen management, avoid any loopholes in the entire critical value process, and ensure patients are protected from risks during their medical visits, research has been conducted on the application of this comprehensive critical value management process in clinical laboratory testing.

3. Application of the critical value management function in the laboratory information system (LIS)

Based on “A Brief Analysis of the Clinical Application of Critical Values in Serum Testing” and the “Administrative Measures for Clinical Laboratory Critical Values”, and in conjunction with the critical value management requirements established by the Medical Affairs Department, the clinical laboratory has set corresponding critical value thresholds for various specimen types, genders, and age groups [3]. By configuring these thresholds in the LIS system, the system can alert when test results meet critical value criteria. The critical value early warning function of the LIS system in the clinical laboratory is activated, as shown in **Figure 1** [4]. This function reminds laboratory technicians of critical value results during clinical testing. After undergoing review and verification processes, these critical value results are then reported to the clinical department [5].



Figure 1. Critical value alert.

Leveraging the customizable configuration function of audit rules within the Laboratory Information System (LIS), the clinical laboratory has established an intelligent pop-up alert mechanism specifically for critical values. During the result review process conducted by laboratory personnel, the LIS system automatically captures specimen test data and accurately identifies test items that meet the criteria for critical values. Once a critical value result is detected, a prominent alert window immediately pops up on the screen, clearly informing the operator of the presence of critical values in the submitted specimen and providing options on whether to proceed with the review.

This intelligent alert function effectively warns on-duty laboratory technicians to pay immediate attention to abnormal and high-risk test data, prompting them to pause the routine review process. In strict accordance with the hospital's critical value management regulations, staff are required to conduct a thorough, item-by-item verification of specimen information, testing procedures, and instrument status. If necessary, specimens should be retested, and sampling information should be rechecked. By utilizing pre-emptive alerts and interventions, as illustrated in **Figures 2 and 3**, the workflow for test result review is further standardized, enhancing quality control at the critical value stage. This approach helps to avoid missed or erroneous reviews, comprehensively improving the rigor and accuracy of test result reviews, ensuring the safe and reliable transmission of critical clinical data, and fortifying the quality assurance in the preliminary testing phase of clinical diagnosis and treatment.

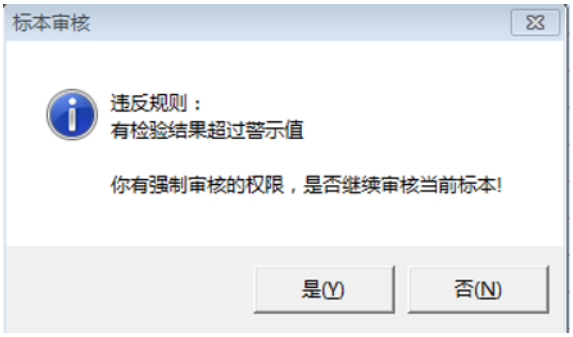


Figure 2. Specimen review alert.



Figure 3. Critical value review control.

Relying on the comprehensive critical value special reporting function of the Laboratory Information System (LIS) for clinical testing, as illustrated in **Figure 4**, the system can automatically identify and screen various critical test values. After completing the result verification and review process, it swiftly and accurately pushes abnormal critical test data to the nurse workstations and clinical physician workstations across all departments in the hospital. The system is equipped with an intelligent pop-up alert and warning module, which promptly displays prominent notifications for critical value information, visually presenting patient details, abnormal items, and test values [6]. This enables efficient online reporting and transmission of critical values, promptly alerting clinical healthcare personnel to quickly become aware of critical indicators, shortening the information transmission time, facilitating immediate clinical intervention and treatment, and effectively ensuring patient safety.

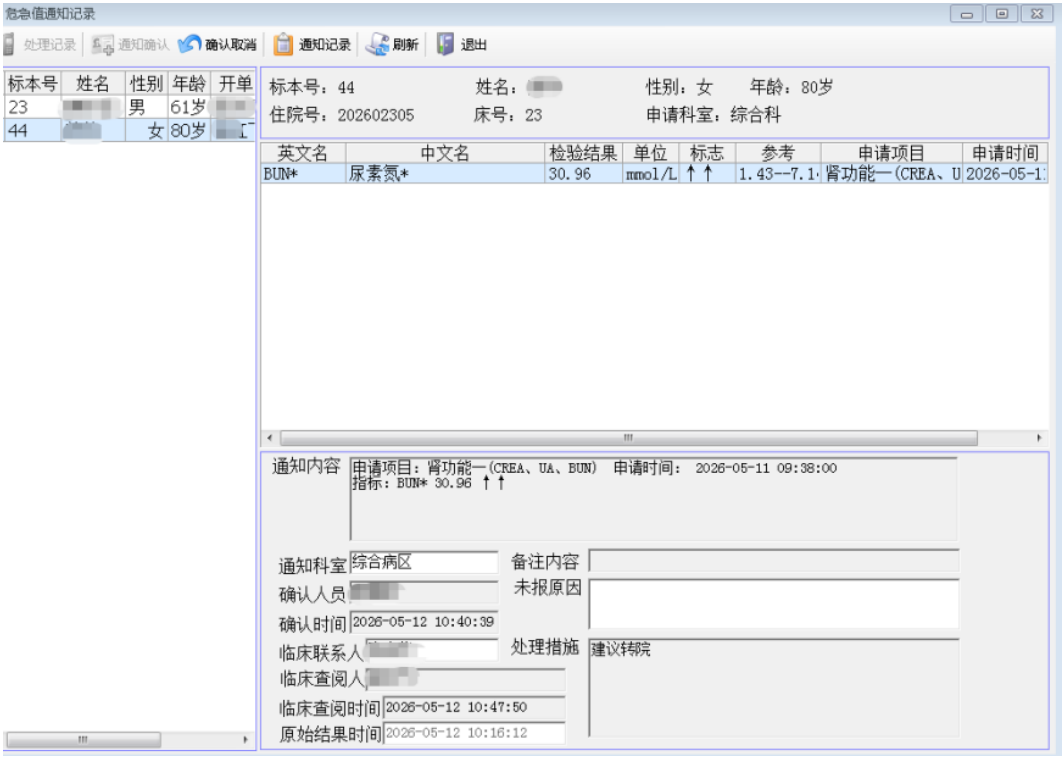


Figure 4. Critical value notification records.

In the database, patient information, test items, test results, reporting times, testers, critical value recipients, critical value handling times, and critical value handling opinions that meet the critical value criteria are retrieved to form a worksheet for the entire process management of critical values. This allows for a clearer review of each stage from the generation to the resolution of a patient's critical value, as well as calculating the time from critical value generation to reporting and the time from clinical physician receipt of the critical value to completion of handling, thereby strengthening patient critical value management [7]. The Medical Affairs Department uses the detailed notification sheet for critical test values, as shown in **Table 1**, to filter out test results without clinical critical value handling opinions and the corresponding clinical physicians. Through this sheet, it is straightforward to calculate metrics such as the number of critical value notifications, the number of unhandled critical values, the critical value notification rate, and the timely critical value notification rate, thereby enhancing the management of the entire process of critical test values.

Table 1. Detailed notification of critical test values

Review Period: From 00:00:00 on April 1, 2026, to 23:59:59 on April 30, 2026

Reporting time	Medical record No.	Patient source	Name	Sex	Age	Bed No.	Requesting department	Notified person	Notification status
2026-04-01 08:39:06	2604010009	Outpatient		Female	65		Outpatient internal medicine		Read
2026-04-02 08:32:17	2305160017	Outpatient		Male	59		Outpatient internal medicine		Read
2026-04-02 09:37:50	202601702	Inpatient		Male	62	6	General medicine		Read
2026-04-02 12:28:29	202601725	Inpatient		Female	61	29	Surgery		Read

Continue Table 1. Detailed notification of critical test values

Specimen No.	Notification content	Recipient	Notified department	Message confirmed by	Message confirmation time	Treatment measures	Processing time	Specimen No.
23	Requested test: Complete Blood Count (New) Request time: 2026/4/1 8:17:00 Indicator: PLT* 33.20 ↓↓		Outpatient internal medicine		2026-04-01 09:07:26	Recommend further examination at a higher-level hospital hematology department.	29	23
21	Requested test: Complete Blood Count (New) Request time: 2026/4/2 7:59:00 Indicator: WBC* 112.81 ↑↑		Outpatient internal medicine		2026-04-02 09:45:32	Recommend further treatment at a higher-level hospital hematology department.	74	21

21	Requested tests: Renal function, Electrolytes, Blood glucose, Liver function (inpatient), Blood lipids (inpatient) Request time: 2026/4/1 9:02:00 Indicator: K* 2.67 ↓↓	General medicine ward	2026-04-02 10:44:33	Recheck serum potassium	67	21
18	Requested tests: Coagulation panel, D-dimer Request time: 2026/4/2 10:47:00 Indicator: D-Dimer 15.95	Surgery ward	2026-04-02 12:37:14	Regular follow-up	9	18

4. Clinical control of critical value management

At the clinical physician workstation, a function for filling in handling opinions for patients' critical value results has been enabled, requiring clinicians to document their handling opinions and implement the critical value management process. To enhance the timeliness of critical value handling and prevent omissions, our hospital has introduced a function at the clinical physician workstation that prevents the saving and sending of clinical orders if critical values remain unaddressed. During this process, through program control, doctors are strictly required to prioritize completing and implementing the handling of critical value opinions before they can proceed with issuing further orders, thereby improving the timeliness of critical value management by clinicians.

As shown in **Figure 5**, within the zl_advicecheck function responsible for saving and sending orders at the clinical physician workstation, a parameter v_unhandled_critical_value is defined. This parameter retrieves information from the patient's critical value records to determine whether the patient has any unhandled critical values and assesses their quantity. If unhandled critical values are identified, the system returns the instruction: "This patient has recent unhandled critical value records. Please address them before issuing orders", as depicted in **Figure 6**.

```
--有未处理危急值，则禁止保存医嘱
if 调用场合_in = 2 then
   select count(*) into v_未处理危急值 from 病人危急值记录 f where f.病人id = 病人id_In and f.主页id = 就诊id_In and f.状态 = 1 and f.报告时间 > trunc(sysdate) -3;
   if v_未处理危急值 > 0 then
     v_Return:= '2|' ||'此患者近期有未处理危急值记录，请先处理后在开医嘱！';
   end if;
else
  select count(*) into v_未处理危急值 from 病人危急值记录 f,病人挂号记录 j where f.病人id = 病人id_In and f.病人id = j.病人id
        and f.挂号单 = j.no and j.id = 就诊id_In and f.状态 = 1 and f.报告时间 > trunc(sysdate) -3;
   if v_未处理危急值 > 0 then
     v_Return:= '2|' ||'此患者近期有未处理危急值记录，请先处理后在开医嘱！';
   end if;
end if;
--有未处理危急值，则禁止保存医嘱
```

Figure 5. Control program for unhandled clinical critical values.

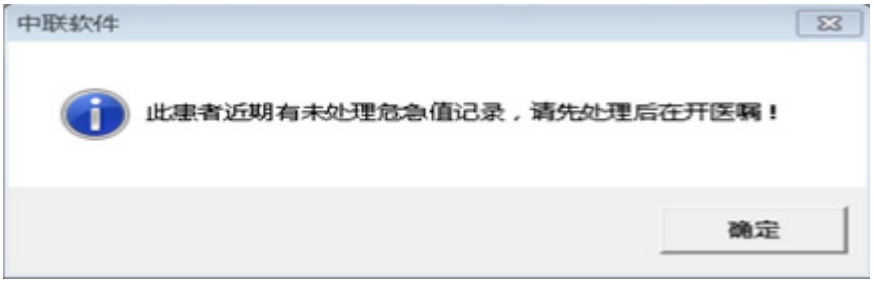


Figure 6. Control interface for unhandled clinical critical values.

5. SMS notification for critical laboratory values

During the generation and handling of critical values, there may still be instances where the clinical laboratory fails to report critical values in a timely manner or where clinicians do not address them promptly. To prevent and eliminate such occurrences, an SMS reminder function has been introduced at both the critical value generation and clinician handling stages [8]. By utilizing the database, a view for critical value alerts and reminders has been developed. This view pushes patient information and critical value results for cases where critical values have not been reported within 30 minutes of generation, as well as patient information and critical value results for cases where clinicians have received critical values but have not completed handling, to an SMS platform. The SMS platform then sends patient information and critical value management advice to the mobile phones of laboratory technicians or clinicians, enhancing reminders for the handling of patient critical values. See **Table 2**.

Table 2. Monthly critical value notification and timely handling rate (2026)

Month	Total	Number reported	Reporting rate	Number unprocessed	Number processed	Timely rate (30 min)
January	92	92	100%	7	64	69.6%
February	106	106	100%	5	82	77.4%
March	99	99	100%	4	81	81.7%
April	83	83	100%	2	74	89.2%
May	53	53	100%	1	48	90.6%

6. Summary and discussion

The process transformation of critical value management in the clinical laboratory of our hospital has been continuously improved and optimized in recent years, serving as a crucial technical approach to enhance medical standards and reduce medical risks. Highlighted by the clinical control of unhandled critical values and SMS notifications, this transformation represents the clinical laboratory's independent innovation and the integration of laboratory technology with information technology across multiple disciplines.

Since the implementation of this project, the number of critical value notifications from the clinical laboratory in 2026 has shown a downward trend, with a notification rate of 100%. The number of unhandled cases has also decreased, primarily due to unfilled critical value handling forms resulting from patient transfers from outpatient or emergency departments. The timely handling rate of critical values has continuously improved, and clinicians' awareness of managing critical values has been significantly

enhanced.

Through systematic upgrades to the entire process of reporting, reviewing, notifying, tracking, and reviewing critical values in the clinical laboratory, this study has further optimized the hospital's standardized management system for critical values, addressing issues such as outdated processes, loopholes, and weak control in the original system. Relying on the Medical Affairs Department's professional and regular supervision and management functions, we have established a dual management model that combines departmental self-inspections with functional department oversight, ensuring a fully closed-loop regulatory process for critical value handling.

Under this new management system, this study has continuously strengthened the sense of responsibility and medical safety awareness among laboratory technicians and clinicians, clarifying job responsibilities and work standards for each position in critical value identification, verification, and notification, receipt and confirmation, clinical handling, and result feedback. Through regular training, daily supervision, case reviews, and error evaluations, we have eliminated issues such as missed, delayed, or incorrect reporting of critical values, as well as untimely clinical handling and non-standard recording, thereby avoiding diagnostic and therapeutic safety hazards at both process and personnel levels and effectively preventing various medical errors and accidents.

Furthermore, the standardized, closed-loop critical value management model has further solidified the foundation of medical quality and safety management in our hospital, addressed previous quality management shortcomings, improved the implementation system of core medical regulations, and effectively enhanced the overall medical quality and safety control standards of the hospital. This lays a solid foundation for the hospital's regular quality control efforts and the smooth progress of graded hospital evaluations.

Disclosure statement

The author declares no conflict of interest.

References

[1] Zhang Y, 2021, Application of a Fully Information-Based Closed-Loop Management System for Critical Value Reporting in the Clinical Laboratory. Journal of Traditional Chinese Medicine Management, 29(13): 199–200.

[2] Zhang L, 2026, Construction and Practical Exploration of a Clinical Laboratory Critical Value Reporting System. Proceedings of the Fourth Medical Health and Management Academic Exchange Conference.

[3] Jia J, 2018, A Brief Analysis of the Clinical Application of Critical Values in Serum Testing. China Rural Health, 2018(07): 73 + 75.

[4] Fang X, 2014, Clinical Application Management and Continuous Improvement of Critical Values in Laboratory Testing. Hospital Management Forum, 31(01): 26–27 + 50.

[5] Zhang P, He L, 2017, Implementation of Closed-Loop Management for Critical Values in Laboratory Testing Using Information Systems. Inner Mongolia Science, Technology, and Economy, 2017(21): 70–71.

[6] Sun J, Xu W, Ren J, 2014, Research on Establishing a Tracking and Early Warning Mechanism for Critical Value Reporting in Laboratory Testing Under the Context of Information-Based Management. Laboratory Medicine, 29(04): 380–383.

[7] Xia J, Hu Y, Zhang S, et al., 2025, Construction and Application of a Knowledge-Based Intelligent Management

Platform for Hospital Critical Values. China Medical Equipment, 40(04): 66–72.

[8] Xu W, Sun J, 2013, Research on the Application Value of an Information Technology Platform in Critical Value Reporting in Laboratory Testing. International Journal of Laboratory Medicine, 34(19): 2634–2635.

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Improving Early Sepsis Recognition and Timely Antibiotic Administration in the Emergency Department: A PDCA-Based Quality Improvement Initiative

Xiaojuan Zhu, Haoran Wang, Hee King Su*

Emergency Department, Beijing United Family Hospital, Beijing 100016, China

Author to whom correspondence should be addressed.

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Abstract: *Background*: Sepsis is a life-threatening condition associated with substantial morbidity, mortality, and healthcare utilization. In the emergency department (ED), early recognition and prompt antibiotic administration are essential components of high-quality care. In 2024, compliance with timely antibiotic administration for sepsis in our ED fell below the institutional target, with recurrent delays observed in obstetric and gynecologic (OB-GYN) presentations. *Objective*: To improve early sepsis recognition and increase the rate of timely antibiotic administration in the ED using a Plan-Do-Check-Act (PDCA) quality improvement framework. *Methods*: We conducted a single-center quality improvement initiative in the ED of Beijing United Family Hospital. Interventions included implementation of a triage sepsis alert, screening with the National Early Warning Score 2 (NEWS2), a standardized sepsis order set, workflow standardization, targeted staff education on atypical and OB-GYN sepsis presentations, and monthly audit-and-feedback cycles. The primary outcome was the proportion of ED patients with sepsis or septic shock who received antibiotics within the target time window after recognition. Secondary process measures included time from triage to antibiotic order, time from order to administration, and time from triage to first antibiotic dose. *Results*: Following implementation, timely antibiotic administration improved from 33% at baseline to 100% from August 2024 through January 2025. Although monthly case numbers were small, sustained full compliance across consecutive months suggested improved process reliability. The mean time from triage to antibiotic order was approximately 5 minutes, the mean time from order to administration was approximately 6 minutes, and the mean time from triage to first antibiotic dose was approximately 11 minutes. *Conclusion*: A PDCA-based sepsis quality improvement initiative was associated with substantial and sustained improvement in timely antibiotic administration in the ED. Standardized recognition processes, clear escalation pathways, and continuous feedback may improve the reliability of sepsis care, including in atypical presentations such as OB-GYN cases.

Keywords: Sepsis; Septic shock; Emergency department; Quality improvement; PDCA; Antibiotics; NEWS2

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1. Introduction

Sepsis, defined by the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3), is a life-threatening organ dysfunction caused by a dysregulated host response to infection [1]. In clinical practice, organ dysfunction is commonly operationalized as an increase of 2 or more points in the Sequential Organ Failure Assessment (SOFA) score in a patient with suspected or confirmed infection [1]. Septic shock is a severe subset of sepsis characterized by persistent hypotension requiring vasopressor therapy to maintain a mean arterial pressure of at least 65 mmHg and a serum lactate level greater than 2 mmol/L despite adequate fluid resuscitation [2].

Sepsis remains a major global health burden and is associated with substantial morbidity, mortality, prolonged hospitalization, intensive care utilization, and increased healthcare costs [3,4]. A global burden analysis estimated that sepsis accounted for 48.9 million cases and 11.0 million deaths worldwide in 2017 [3]. Mortality is particularly high in patients with septic shock, underscoring the need for early recognition and timely treatment [3,4]. Current international guidelines emphasize prompt initiation of evidence-based management, including early antimicrobial therapy, hemodynamic resuscitation, and source control where indicated [4].

Historically, sepsis recognition in the ED has relied heavily on clinician judgment, intermittent vital sign assessment, and the identification of overt clinical deterioration. This approach may delay diagnosis, especially in patients with atypical presentations or subtle early physiologic abnormalities, and such delays are associated with worse outcomes [4,5]. In recent years, sepsis care has evolved through the use of standardized screening tools, electronic alerts, and real-time monitoring systems to support earlier identification of high-risk patients [5,6]. These systems can strengthen detection but should be viewed as adjuncts to, rather than replacements for, clinical judgment.

In the ED, sepsis is an important quality target because it is common, time-sensitive, and highly dependent on the timeliness of initial management [4]. Among the key process measures in sepsis care, timely antibiotic administration is especially critical. However, performance may be limited by delayed recognition, workflow variability, and inconsistent implementation of sepsis pathways [4]. In response to these challenges, our ED implemented a structured quality improvement initiative based on the PDCA framework to improve early sepsis recognition and timely antibiotic delivery.

2. Objectives

This project aimed to:

(1) Increase the rate of timely antibiotic administration for ED patients with sepsis or septic shock to a target of at least 98%, with a minimum acceptable threshold of 90%.
(2) Standardize early sepsis recognition at triage using a sepsis alert and screening tool.
(3) Implement a sepsis order set to improve the reliability of bundle elements, including lactate measurement, blood cultures before antibiotics when appropriate, fluid resuscitation, reassessment, and documentation.
(4) Address recognition gaps in OB-GYN sepsis presentations through targeted education on pregnancy-related warning signs and escalation pathways.
(5) Establish continuous monthly monitoring using audits and run charts to identify variation and support rapid corrective action.

(6) Sustain improvement through case review, multidisciplinary feedback, and refresher training.

3. Methods

3.1. Study design and setting

This was a single-center quality improvement project conducted in the ED of Beijing United Family Hospital. The project used the PDCA framework to improve the timeliness and reliability of sepsis care processes.

3.2. Intervention

The intervention included several coordinated components:

(1) Implementation of a triage sepsis alert within the nursing platform;
(2) Use of a standardized screening process incorporating NEWS2;
(3) Deployment of a standardized sepsis order set;
(4) Workflow standardization for diagnosis documentation and treatment initiation
(5) Immediate physician notification for patients with abnormal vital signs at triage; and
(6) Targeted education for ED and triage teams, with particular emphasis on OB-GYN sepsis presentations.

3.3. Measures

The primary performance indicator was the sepsis antibiotic administration rate. The numerator was the number of adult ED patients with sepsis or septic shock who received antibiotics within the defined target time after recognition. The denominator was the number of ED patients with a sepsis alert or positive screening result and a final diagnosis of sepsis or septic shock. Performance was tracked through monthly audits using alert logs, screening forms, and timestamp review.

Secondary process measures included time from triage to antibiotic order, time from antibiotic order to administration, and total time from triage to first antibiotic dose.

3.4. Improvement cycle

Monthly performance data were reviewed to identify gaps and guide countermeasures. When performance fell below the threshold, the team reinforced education, refined alert criteria, optimized order set use, and conducted focused case reviews. Effective practices were retained through ongoing monitoring, feedback, and refresher training. See **Figure 1**.

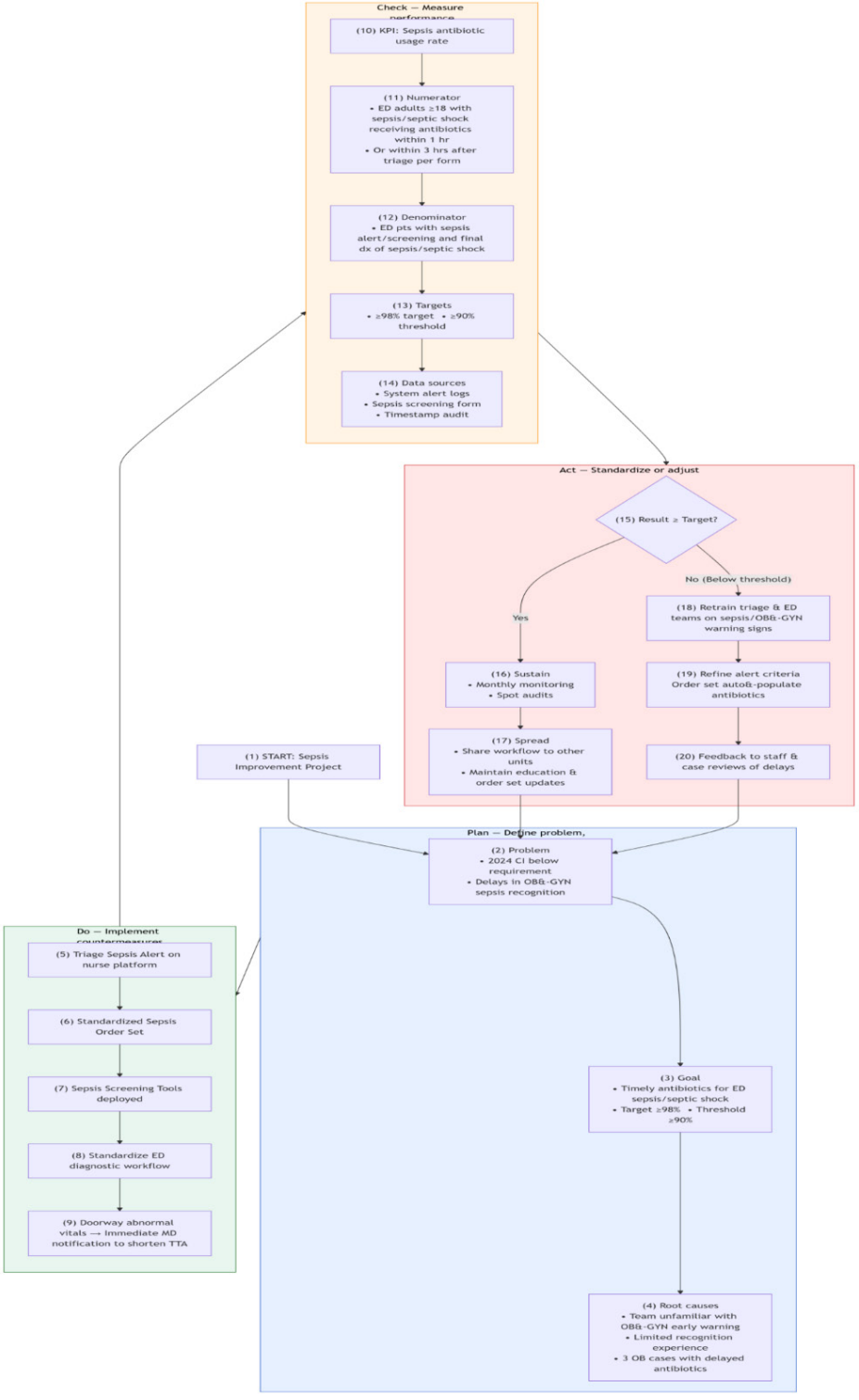


Figure 1. Monthly performance data.

4. Results

Following implementation of the PDCA-based intervention, timely antibiotic administration improved markedly. Monthly compliance increased from a baseline low of 33% to 100% from August 2024 through

January 2025. Although monthly case numbers were small, sustained achievement of 100% across multiple consecutive months suggests a meaningful improvement in process reliability rather than random variation.

NEWS2-triggered alerts clustered in clinically important acuity ranges, particularly scores of 5 to 7, indicating that the revised workflow was being applied in patients at meaningful risk of deterioration. This finding supports the clinical relevance of the intervention and suggests that the improvement was not solely attributable to documentation changes.

Process timing also improved substantially. The mean time from triage to antibiotic order was approximately 5 minutes, the mean time from order to administration was approximately 6 minutes, and the mean time from triage to first antibiotic dose was approximately 11 minutes. Together, these findings suggest that both recognition and operational execution improved after implementation.

5. Discussion

This quality improvement initiative was associated with substantial improvement in the timeliness of antibiotic administration for ED patients with sepsis. The findings suggest that sepsis care can be strengthened through a combination of standardized screening, simplified ordering, visible triage prompts, and continuous performance feedback.

Several factors likely contributed to the observed improvement. First, standardization reduced variation in early recognition and treatment initiation. Second, the sepsis order set appeared to streamline clinician decision-making and reduce delays between recognition and action. Third, targeted education addressed an important gap in atypical or less familiar sepsis presentations, particularly in OB-GYN cases. Finally, continuous audit and feedback supported rapid identification of barriers and reinforcement of desired practices.

The observed treatment intervals were favorable and suggest improvement in both the cognitive and operational components of care. The short interval from triage to order implies faster recognition and decision-making, while the short interval from order to administration suggests efficient nursing and medication-delivery processes. Together, these changes indicate a more reliable end-to-end sepsis workflow.

This study has several limitations. It was conducted at a single center, and the monthly number of sepsis cases was small, which limits statistical inference and generalizability. In addition, the project focused primarily on process measures rather than patient-centered clinical outcomes such as mortality, intensive care unit admission, or hospital length of stay. The impact of the intervention on these downstream outcomes remains to be determined. Future work should evaluate long-term sustainability and assess whether similar interventions can be scaled to other departments or patient populations.

6. Conclusion

A PDCA-based sepsis quality improvement initiative in the ED was associated with rapid and sustained improvement in timely antibiotic administration. Standardized triage alerts, structured screening, a sepsis order set, targeted staff education, and continuous feedback together improved workflow reliability and reduced treatment delays. These findings support the use of practical, system-based interventions to strengthen early sepsis care in the ED [7].

Disclosure Statement

The authors declare no conflicts of interest.

References

[1] Singer M, Deutschman C, Seymour C, et al., 2016, The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA, 315(8): 801–810.

[2] Shankar-Hari M, Phillips G, Levy M, et al., 2016, Developing a New Definition and Assessing New Clinical Criteria for Septic Shock: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA, 315(8): 775–787.

[3] Rudd K, Johnson S, Agesa K, et al., 2020, Global, Regional, and National Sepsis Incidence and Mortality, 1990–2017: Analysis for the Global Burden of Disease Study. Lancet, 395(10219): 200–211.

[4] Evans L, Rhodes A, Alhazzani W, et al., 2021, Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021. Intensive Care Medicine, 47(11): 1181–1247.

[5] Seymour C, Gesten F, Prescott H, et al., 2017, Time to Treatment and Mortality During Mandated Emergency Care for Sepsis. New England Journal of Medicine, 376(23): 2235–2244.

[6] Horng S, Sontag D, Halpern Y, et al., 2017, Creating an Automated Trigger for Sepsis Clinical Decision Support at Emergency Department Triage Using Machine Learning. PLoS One, 12(4): e0174708.

[7] Fleuren L, Klausch T, Zwager C, et al., 2020, Machine Learning for the Prediction of Sepsis: A Systematic Review and Meta-Analysis of Diagnostic Test Accuracy. Intensive Care Medicine, 46(3): 383–400.

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Application Analysis of Tongue Muscle Training Combined with Respiratory Training Intervention for Dysphagia after Stroke

Ting Ye[1,4], Jing Gao[2], Zhaoxiang Meng[1,3]*

[1]Yangzhou University Faculty of Medicine, Yangzhou 225009, Jiangsu, China
[2]Huaian Maternal and Child Health Hospital, Huaian 223001, Jiangsu, China
[3]Northern Jiangsu People's Hospital Affiliated to Yangzhou University, Yangzhou 225001, Jiangsu, China
[4]Shuyang Hospital of Traditional Chinese Medicine, Suqian 223600, Jiangsu, China

Author to whom correspondence should be addressed.

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Abstract: *Objective:* To explore the effects of tongue muscle training combined with respiratory training intervention on patients with dysphagia after stroke. *Methods:* A total of 70 patients with dysphagia after stroke admitted to our hospital from January 2025 to January 2026 were selected for the study and randomly divided into two groups. The control group (35 cases) underwent conventional rehabilitation training, while the observation group (35 cases) focused on tongue muscle training combined with respiratory training intervention. The intervention effects were compared between the two groups. *Results:* Before the intervention, there were no significant differences in swallowing function, respiratory function, and nutritional indicators between the two groups ($p > 0.05$). After the intervention, the observation group showed greater improvements in tongue muscle strength and swallowing laryngoscopy scores, as well as lower dysphagia scores and better respiratory function, with significant differences compared to the control group ($p < 0.05$). *Conclusion:* Tongue muscle training combined with respiratory training intervention can improve swallowing function and overall quality of life in patients with dysphagia after stroke, making it worthy of promotion.

Keywords: Tongue muscle training; Respiratory training; Stroke; Dysphagia

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1. Introduction

Stroke is a critical and life-threatening condition with a high incidence rate, high disability rate, and numerous complications, posing a significant threat to the physical health and quality of life of elderly individuals. Dysphagia is the most common complication after stroke, characterized by symptoms such as delayed tongue muscle movement, poor coordination of pharyngeal muscles, and impaired swallowing-breathing rhythm [1]. This complication not only leads to adverse reactions such as malnutrition, dehydration,

and aspiration pneumonia but also increases the risk of prolonged hospitalization and mortality, making it an important risk factor affecting the recovery of neurological and physical functions in patients. Swallowing is a delicate physiological activity involving the coordinated participation of tongue muscles, laryngeal muscles, and respiratory muscles, with precise coordination between elastic contraction and respiratory rhythm being crucial for normal swallowing [2]. According to the coordination mechanism of swallowing movement, respiratory training can adjust thoracoabdominal breathing patterns, correct swallowing-breathing difficulties, and reduce the risk of aspiration by enhancing tongue muscle strength, improving tongue flexibility, and enhancing the squeezing effect of swallowing [3]. This study aimed to explore the effects of tongue muscle training combined with respiratory training intervention on patients with dysphagia after stroke, with the analysis presented as follows.

2. General information and research methods

2.1. Data

Seventy patients with swallowing dysfunction after stroke admitted to our hospital from January 2025 to January 2026 were selected for the study and randomly divided into two groups. In the control group, there were 20 males and 15 females, aged between 59 and 78 years, with an average age of (68.45 ± 2.36) years. In the observation group, there were 19 males and 16 females, aged between 60 and 78 years, with an average age of (68.89 ± 2.45) years. No statistically significant differences were observed in the basic data between the two groups ($p > 0.05$). This study adhered to medical ethical guidelines and did not conflict with national laws and regulations.

2.1.1. Inclusion criteria

(1) Patients were clinically diagnosed with stroke and confirmed by head CT, MRI, or other imaging modalities;
(2) Patients had mild to moderate swallowing dysfunction as diagnosed by the Watian Drinking Water Test and imaging;
(3) Patients were conscious and able to cooperate with rehabilitation exercises.

2.1.2. Exclusion criteria

(1) Patients with concurrent oral diseases or esophageal cancer;
(2) Patients with dysfunction of vital organs;
(3) Patients with cognitive dysfunction unable to cooperate with training;
(4) Patients with severe hemiplegia.

2.2. Methods

2.2.1. The control group received conventional rehabilitation training

Daily swallowing function rehabilitation treatment was provided to the control group for 4 weeks, with continuous intervention for 6 days per week, once a day, and 30 minutes each time. First, basic oral and maxillofacial exercises were conducted, guiding patients to perform puffing and closing of the cheeks and relaxation exercises of the facial muscles to enhance the strength of the oral muscles. Second, pharyngeal stimulation exercises were performed using a cotton swab to stimulate the patient's soft palate, tongue, and

throat, utilizing sensory stimulation to restore the pharyngeal reflex. Third, basic swallowing exercises were conducted, instructing patients to swallow air while maintaining balance in the head and neck and using a standard swallowing force method. Fourth, dietary guidance was provided to adjust the patient's swallowing function, focusing on thin and thick liquid foods, and guiding patients to chew slowly and avoid aspiration caused by eating too quickly. This was combined with clinical standard neuromuscular electrical stimulation therapy. Parameter settings: pulse frequency 80 Hz, pulse width 700 μs, stimulation intensity adjusted to produce obvious contraction of the patient's local muscles without pain, single stimulation duration 20 minutes, once a day, and continuous intervention for 6 days per week.

2.2.2. The observation group focused on implementing tongue muscle training combined with respiratory training interventions

The exercises were conducted twice a day for 30 minutes each time, once in the morning and once in the afternoon, for a total of 4 weeks, 6 days per week. Specifically, it included:

(1) Specialized tongue muscle training

15 minutes each session, ① Tongue muscle strength training: Patients were instructed to maintain a sitting position with shoulders and neck relaxed, extend their tongue out of the mouth as far as possible, hold the extended position for five seconds, and then slowly retract it. Subsequently, they were instructed to perform actions such as lifting the tip of the tongue to press against the hard palate and pushing it down to press against the lower gingiva, with 15 repetitions per set, completing a total of 3 sets, with a 15-second rest between sets. For patients with weak tongue muscle strength who were unable to perform the extension independently, nurses could wrap the tongue with sterile gauze to assist in traction, gradually restoring normal tongue muscle activity. ② Tongue flexibility exercises: Patients were guided to perform 10 clockwise rotations and 10 counterclockwise rotations of the tongue inside the mouth; subsequently, the tip of the tongue was alternately pressed against the inner side of the left and right masseter muscles (holding for 1 second on each side). ③ Tongue resistance strength training: A sterilized tongue depressor (or spoon handle) was selected. The tongue depressor was placed flat on the patient's tongue surface, and the patient was instructed to exert upward force with the tongue to press against the tongue depressor, maintaining maximum contraction for 8 seconds and then relaxing for 2 seconds. The above was considered one set of actions, with a total of 4 sets completed. A 10-second rest was taken between sets. Each set consisted of 10 repetitions, completing a total of 3 sets, with a 10-second rest between sets. ④ Tongue-throat coordination training: Patients were guided to lift the tip of the tongue to press against the hard palate, causing the entire tongue surface to adhere to the hard palate (simulating the action of holding food), followed by a single dry swallowing motion. Each set consisted of 12 repetitions, completing 3 sets, with a 10-second rest between sets. All training should be conducted within the patient's physical capacity. If fatigue is felt, the number of repetitions can be appropriately reduced and gradually increased later.

(2) Specialized respiratory training

15 minutes each time, ① Warm-up phase: Calm breathing combined with shoulder and neck relaxation training for 1 minute. ② Abdominal breathing training: Patients were placed in a semi-reclining or sitting position with both hands placed on the abdomen. They were instructed to inhale through the nose (2 seconds) to cause the abdomen to bulge and exhale through pursed lips (4 seconds) to cause the abdomen to contract. Each set consisted of 10 repetitions, with a 20-second rest between sets and a total of 3 sets completed.

③ Pursed-lip breathing training: After inhaling through the nose for 2 seconds, patients were instructed to exhale slowly for 6 seconds with pursed lips as if blowing a whistle. Each set consisted of 8 repetitions, with a 30-second rest between sets and a total of 2 sets completed. ④ Resisted respiratory training: An inspiratory muscle trainer (initial resistance set at 30–50% of maximum inspiratory pressure) was used. Patients were instructed to inhale deeply and quickly as much as possible, hold their breath for 1 second, remove the mouthpiece, and exhale through pursed lips. After each inhalation, patients were instructed to breathe calmly for 2–3 times before proceeding to the next inhalation. Each set consisted of 6 repetitions, with a 30-second rest between sets and a total of 3 sets completed. If a decrease in blood oxygen saturation of ≥ 3%, an increase in heart rate of ≥ 20 beats per minute, significant dizziness, or signs of aspiration (coughing, wet voice, etc.) occur during training, training should be terminated immediately.

2.3. Observation indicators

(1) The swallowing function of patients in both groups was observed, including tongue muscle strength and standard swallowing function, which were recorded before and after intervention [4]. The standardized assessment of tongue muscle strength was used to quantitatively evaluate the muscle strength during tongue protrusion, retraction, elevation, and lateral movement, accurately assessing the recovery of tongue muscle motor function. The standard swallowing function assessment scale (SSA) was used to assess swallowing ability, with scores ranging from 18 to 46. A higher score indicated better swallowing ability. To improve the scientificity and accuracy of the evaluation, swallowing laryngoscopy was used as the "gold standard" to visually observe the oral and pharyngeal movements of patients, and the FEES (fibroendoscopic evaluation of swallowing) quantitative scoring standard (0–10 points, with higher scores indicating better swallowing function) was used [5].

(2) Respiratory function indicators of patients in both groups were observed, including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and peak expiratory flow rate (PEF).

2.4. Statistical analysis

Experimental data were properly processed using SPSS 24.0 software. Measurement data were presented as mean ± standard deviation ($\overline{x} \pm s$), and comparisons between groups were made using the *t*-test. Categorical data were presented as percentages (%) and analyzed using the chi-square test (χ^2 test). Significant differences were considered when $p < 0.05$.

3. Results

3.1. Comparison of swallowing function between the two groups of patients

Before intervention implementation, the performance of the two groups in terms of tongue muscle strength and swallowing function was similar, with no significant differences ($p > 0.05$). After intervention, the tongue muscle strength and swallowing laryngoscopy scores of patients in the observation group improved more significantly, while the swallowing dysfunction scores decreased more significantly, with significant differences compared to the control group ($p < 0.05$), as shown in **Table 1**.

Table 1. Comparison of swallowing function between the two groups of patients ($\overline{x} \pm s$, points)

Group	Number of cases	Tongue muscle strength		SSA		Swallowing endoscopy score	
		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Control group	35	4.21 ± 1.33	6.03 ± 1.25	28.64 ± 2.34	22.34 ± 2.55	4.26 ± 0.66	6.31 ± 0.55
Observation group	35	4.32 ± 1.26	8.31 ± 1.13	28.71 ± 2.25	19.61 ± 2.26	4.28 ± 0.59	7.65 ± 0.63
t		0.355	8.005	0.128	4.740	0.124	8.776
p		0.724	< 0.001	0.899	< 0.001	0.902	< 0.001

3.2. Comparison of respiratory function indicators between the two groups of patients

Before the intervention, there were no significant differences in respiratory function indicators between the two groups ($p > 0.05$). After the intervention, the indicators in the observation group were higher than those in the control group, with significant differences ($p < 0.05$), as shown in **Table 2**.

Table 2. Respiratory function indicators of the two groups of patients ($\overline{x} \pm s$)

Group	Number of cases	FVC(L)		FEV1(L)		PEF(L/min)	
		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Control group	35	1.82 ± 0.46	2.15 ± 0.59	1.50 ± 0.31	1.89 ± 0.23	325.64 ± 3.59	380.59 ± 3.12
Observation group	35	1.84 ± 0.39	2.86 ± 0.61	1.53 ± 0.26	2.17 ± 0.23	325.58 ± 3.26	386.54 ± 3.26
t		0.196	4.950	0.439	5.093	0.073	7.801
p		0.845	0.000	0.662	0.000	0.942	0.000

4. Discussion

Stroke patients often experience reduced tongue muscle strength, weakened tongue mobility, slowed pharyngeal reflexes, and slower breathing and swallowing rhythms. These issues prevent patients from swallowing normally, leading to difficulties in eating, choking, and a series of other manifestations. Without intervention, patients may not receive adequate nutrition and are prone to aspiration, resulting in a range of complications such as pneumonia and malnutrition. This not only delays the recovery process of neurological function but also affects the patient's quality of life [6–9].

Tongue muscle training targets various muscle groups of the tongue from multiple aspects, including muscle strength, flexibility, pressure, and coordination [10]. By activating tongue motor neurons, it accelerates the repair of damaged neural pathways, alleviates tongue muscle atrophy, and gradually improves muscle contractility and flexibility [11]. Standardized tongue muscle rehabilitation exercises can rebuild tongue surface movement patterns, correct unnatural phenomena such as tongue lateral displacement and uncoordinated movements, and enhance the tongue's ability to push, suck, and squeeze food [12]. Respiratory training, utilizing abdominal breathing and pursed-lip breathing exercises, can improve patients' thoracic breathing patterns, enhance the muscle strength of the diaphragm and intercostal muscles, improve pulmonary ventilation, stabilize resting breathing rhythms, and reduce ineffective breathing movements [13].

The results of this study show that compared to the control group, patients in the observation group

experienced greater improvements in tongue muscle strength and swallowing laryngoscopy scores, along with lower swallowing dysfunction scores and enhanced respiratory function indicators. The reason is that through coordinated practice of swallowing rhythms, patients can develop standardized breathing and swallowing sequences at different times, thereby avoiding aspiration caused by inhalation. Resistance breathing training can improve the endurance and control of respiratory muscles, enabling patients to accurately regulate their breathing frequency to meet their needs [14,15]. After intervention, the respiratory rate of the observation group gradually stabilized, and the consistency of their breathing rhythms significantly improved. Their motor coordination was also significantly better than that of the control group, suggesting that improving patients' respiratory regulation can restore them to a normal state.

5. Conclusion

In conclusion, the combined approach of tongue muscle training and respiratory training meets the rehabilitation needs of stroke patients with swallowing disorders. Specifically repairing the key functions of the tongue muscles and improving patients' pulmonary ventilation and respiratory muscle function can comprehensively enhance patients' swallowing ability, improve their dietary and nutritional status, and reduce the occurrence of complications.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Li N, 2026, Effects of Early Oral Muscle Biofeedback Training Combined with Swallowing Rehabilitation Therapy on Swallowing Function and Quality of Life in Patients with Dysphagia After Stroke. Contemporary Medical Forum, 24(11): 34–36 + 40.

[2] Gao C, Wang Y, Song Z, et al., 2026, Scope Review of Tongue Muscle Training in Patients with Dysphagia After Stroke. Geriatric Medicine Research, 7(01): 74–78 + 84.

[3] Xu Z, Wang Q, 2026, Application of Oral Yoga Combined with Tongue Pressure Resistance Training in Patients with Dysphagia After Stroke. Journal of Clinical Nursing, 25(01): 53–55.

[4] Wang S, Fan B, Jin C, 2026, Effects of Swallowing-Breathing Coordination Training Combined with Tongue Pressure Resistance Feedback Training on Hyoid Bone Motor Function and Eating Ability in Patients with Dysphagia After Stroke. Heilongjiang Medicine Journal, 50(02): 223–225.

[5] Luo Y, Chen A, Li M, et al., 2026, Application of Modified Volume-Viscosity Test Combined with Laryngoscopic Swallowing Function Assessment in Eating Training for Patients with Dysphagia After Stroke. Chinese Journal of General Practice, 24(04): 650–653.

[6] Cui P, Wu J, Chang L, 2025, Effects of Acupuncture with the Method of Connecting Qi and Dredging Meridians Combined with Respiratory Muscle Training on Swallowing Function, Electromyogram Indicators, and Nutritional Status in Patients with Dysphagia After Stroke. Henan Traditional Chinese Medicine, 45(07): 1107–1113.

[7] Liu L, Sa Y, 2025, Effects of Intensive Respiratory Training Combined with Swallowing Function Training on Symptoms and Quality of Life in Patients with Dysphagia After Stroke. Clinical Research and Practice, 10(16):

141–144.

[8] Yuan Y, Sui Y, Wei X, et al., 2025, Effects of Respiratory Training Combined with Individualized Health Education on Swallowing Function in Patients with Dysphagia After Stroke. Clinical Research and Practice, 10(13): 134–137.

[9] Fang Y, Cao X, Chen K, et al., 2025, Effects of Tongue Pressure Resistance Training Combined with Swallowing Function Training on Eating Ability and Swallowing Function in Elderly Patients with Dysphagia After Stroke. Geriatric Medicine and Healthcare, 31(02): 413–417.

[10] Liu Q, Liu X, Wu G, et al., 2025, Application Effect of Respiratory Training Combined with Ice-Acid Stimulation in Stroke Patients with Dysphagia and Pneumonia. Practical Clinical Medicine, 26(02): 7–11 + 45.

[11] Wu L, Cui Y, Zhang Y, et al., 2024, Systematic Analysis of the Rehabilitation Application Effect of Intensive Respiratory Training in Patients with Dysphagia After Stroke. Chinese Journal of General Practice, 22(11): 1967–1970.

[12] Tan L, Li G, Jiang Z, 2025, Clinical Study on Acupuncture Combined with Virtual Scenario Interactive Respiratory Training in the Treatment of Patients with Dysphagia After Stroke. Journal of Practical Traditional Chinese Internal Medicine, 39(08): 101–104.

[13] Liang W, 2024, Observation on the Therapeutic Effect of Swallowing Function Training Combined with a Tongue Muscle Training Device on Dysphagia After Stroke, thesis, Southern Medical University.

[14] Wu Y, Shen B, Li C, et al., 2024, Effects of Neuromuscular Electrical Stimulation Combined with Eating Training Based on Food Form Adjustment on Swallowing Function in Patients with Dysphagia After Stroke. Chinese Journal of Practical Medicine, 51(13): 70–72.

[15] Wang T, Tai J, Hu R, et al., 2022, Effect of Tongue-Pressure Resistance Training in Poststroke Dysphagia Patients with Oral Motor Dysfunction: A Randomized Controlled Trial. American Journal of Physical Medicine & Rehabilitation, 101(12): 1134–1138.

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Construction of an Evaluation Indicator System for Medical MOOCs Quality in China Using Delphi and Analytic Hierarchy Process

He Jiang[1], Yuan Li[1], Hui Chen[2], Chunyan He[2], Samdrup Phuntsok[2], Langtsu Tsering[2], Yinghui Liu[3]

[1]School of Nursing, Tianjin Medical University, Tianjin 300070, China
[2]Department of Medical and Nursing, Changdu Vocational and Technical School, Qamdo 854000, Xizang Autonomous Region, China
[3]Department of Nursing, Children's Hospital, Tianjin University /Tianjin Children's Hospital, Tianjin 300134, China

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Abstract: *Objective:* This study addresses the extensive utilization of Massive Open Online Courses (MOOCs) in medical education and acknowledges the multitude of factors affecting their quality. Given the absence of a scientific and comprehensive assessment system, we aimed to formulate an evaluation indicator system for assessing the quality of medical MOOC construction in China and to determine the weight of each indicator. *Methods:* Using the Donabedian Structure-Process-Outcome model as theoretical guidance and based on relevant literature retrieval and analysis, we first constructed an evaluation indicator system for medical MOOC construction quality. Then, after two rounds of expert consultation, a final indicator content was built, and the weight of the indicators at each level was determined using the Analytic Hierarchy Process (AHP). *Results:* The effective recovery rate of the questionnaires in the two rounds of expert consultation was 68.75% (11/16) and 93.75% (15/16), respectively, and the expert authority coefficient (Cr) was 0.955 and 0.921, respectively. Kendall's W coefficients for indicators at the second and third levels were 0.174 and 0.238, respectively ($p < 0.01$), indicating substantial expert consensus, and the weighted values of the indicators were determined with a consistency ratio (C.R.) < 0.1. Consequently, the final evaluation index system comprises three first-level indicators, six secondary indicators, and 71 tertiary indicators. *Conclusion:* This study successfully established a comprehensive evaluation indicator system for assessing the quality of medical MOOCs, which is characterized by scientific rigor and reliability, and could serve as a valuable reference for evaluating the quality of Medical MOOCs in China.

Keywords: MOOC; Medical education; Indicator system; Delphi method; Analytic hierarchy process

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1. Introduction

Massive Open Online Courses (MOOCs) have emerged as a novel form of open online education, drawing

increasing attention from governmental bodies, educational institutions, and educators since their inception. MOOCs possess distinct advantages when compared to traditional online education, including a wealth of high-quality educational resources, open accessibility, and ease of use [1,2]. Additionally, the COVID-19 pandemic outbreak has stimulated increasing interest and exploration into the possibilities and potential of online education [3]. Notably, in recent years, there has been a significant use of MOOCs. For example, China's MOOC initiative, initiated by universities in 2013, has achieved global leadership and ranks first in regard to scale and adoption over the past decade [4–6].

At present, universities and colleges worldwide are actively launching programs and courses that incorporate MOOCs, thereby indicating that the utilization of mobile and digital technology holds immense significance in medical education. MOOCs have found widespread application in healthcare disciplines, including clinical medicine education. Thus, MOOCs have emerged as a crucial online teaching method, facilitating the sharing of high-quality educational resources and promoting equitable education. However, the growing use of MOOCs has raised questions about their teaching quality. MOOCs have inherent limitations and controversies, including high dropout rates, low completion rates, a lack of standardized criteria for evaluating their quality, and challenges in ensuring effective learning outcomes and teaching quality [7,8]. Overcoming these obstacles is essential for MOOCs to become a dominant educational method in the future, with the quality of course construction playing a central role. As widely acknowledged, multiple factors influence the quality of medical MOOCs, encompassing elements such as the platform, course management, and interactions between teachers and students [9]. Consequently, educators are increasingly conducting research to comprehensively assess course quality and improve it. Indeed, course quality is the linchpin of all education, and any educational format must ensure its quality to achieve long-term viability. Therefore, it is imperative to address the challenge of scientifically and effectively evaluating the educational quality of MOOCs and developing a corresponding evaluation system. This issue holds significant value for all stakeholders, including teachers, students, and MOOC platforms. Medical MOOCs have their distinctive characteristics, requiring course planners and designers to align these curricula with the most current trends in medical developments and clinical environments [10]. Despite existing literature highlighting the pivotal role of quality in MOOCs, there has been relatively limited research on how to conduct a scientific and comprehensive assessment of the quality of medical MOOCs.

Present literature reveals that the evaluation of China's medical MOOCs predominantly follows a summative approach, often neglecting the importance of process evaluation [11]. Some studies highlight the necessity of strong instructional design as a fundamental quality requirement for ensuring the effectiveness of medical MOOCs, while others have focused on elements that affect the quality of medical MOOCs, such as platform design, instructors, and students [1,4,8,9,12,13].

However, it is important to note that there remains a lack of quality index systems or standardized evaluation tools for conducting comprehensive assessments of medical MOOC construction in China [11]. Therefore, it is important to establish a scientific and comprehensive quality indicator system for medical MOOCs, combining expert insights with rigorous statistical methods, as such a system could serve as valuable guidance for the advancement of medical MOOC teaching in China.

2. Methods

The development of the evaluation index system for assessing the quality of medical MOOC construction occurs through three key stages: first, the creation of the initial set of indicator items; second, the establishment and refinement of the indicator system through a Delphi consensus process; and third, the validation of reliability via weight analysis.

2.1. Design

The Delphi technique is a systematic communication approach involving multiple rounds of questionnaires with a panel of experts to achieve consensus [14]. In this research, the Delphi technique was used to analyze preliminary evidence-based indicators from literature through two rounds of expert consultation, such that the opinions of experts were consistent, and finally, the quality indicators were developed. The three-dimensional (Structure-Process-Outcome) quality structure model serves as the theoretical foundation for the development of quality evaluation indicators that explain how structure and process indicators influence outcomes [15]. Using the "three-dimensional quality structure" model as a guiding framework, a preliminary evaluation indicator system for assessing the quality of medical MOOC construction was established based on a relevant literature review and analysis. Then, the Analytic Hierarchy Process (AHP) was used to determine the weights assigned to indicators at all levels.

2.2. Establish a study group

The study group comprises nine members, including two individuals with senior professional titles, three with associate senior professional titles, two with intermediate professional titles, and two medical graduate students. Each member possessed substantial knowledge about the study subjects and was responsible for key tasks, such as literature retrieval, letter inquiry preparation, expert communication and consultation, data collection, and statistical analysis.

The primary roles of the study group included the discussion and assessment of evidence-based indicators, the creation of a preliminary draft of essential indicators, the design of an expert inquiry form, and the selection of members for the Delphi expert study group. The core mission involved assembling specialists with a comprehensive understanding of medical MOOC construction quality and eliciting their insights and opinions regarding the indicator system developed in this study.

2.3. Generation of the first draft

A systematic literature search was performed using CNKI, Wanfang, VIP, PubMed, and Medline databases from the inception of each database using the following main search terms: "MOOC construction quality", "indicator system", "Delphi method", and "Analytic Hierarchy Process (AHP)". Based on the Donabedian three-dimensional quality evaluation model and combined with the literature on the evaluation of MOOC teaching quality, Online teaching quality, and Medical curriculum quality, the research group developed a preliminary draft of the evaluation indicator system, which consisted of 3 first-level indicators, 6 second-level indicators, and 72 third-level indicators. The first draft was verified for readability and feasibility by two medical education experts.

2.4. Delphi process

2.4.1. Confirmation of the expert panel and inclusion criteria

This study selected 15 medical education specialists from universities in 11 cities, including Beijing, Shanghai, Tianjin, Xi'an, etc., utilizing the purposeful sampling method. Inclusion criteria comprised individuals holding an associate senior professional title, possessing a Master's degree or higher, having a minimum of 10 years of experience in medical teaching at a university, involvement in the development of at least one medical MOOC course, granting informed consent, demonstrating active engagement in this study, and a commitment to completing two rounds of questionnaires.

The panel of experts in this study, as summarized in **Table 1**, consisted of individuals aged 40 to 55, with extensive experience in medical teaching ranging from 12 to 39 years. Seven experts held senior professional titles, while five held associate senior professional titles. Among the panel, 12 had obtained Doctoral degrees, and three held Master's degrees.

Table 1. Experts' characteristics

Pseudonym	Gender	Age (years)	Years of teaching in medicine	Regions
E1	Man	41	12	Beijing
E2	Woman	46	25	Shanghai
E3	Man	51	17	Shanghai
E4	Man	40	17	Tianjin
E5	Man	44	18	Wuhan
E6	Man	55	21	Chengdu
E7	Woman	52	17	Nanjing
E8	Woman	46	14	Changsha
E9	Woman	54	39	Changsha
E10	Man	54	25	Changsha
E11	Woman	45	13	Xiamen
E12	Man	48	24	Hangzhou
E13	Woman	55	17	Taiyuan
E14	Woman	50	14	Xi'an
E15	Woman	48	25	Zunyi

The role of the expert panel in this study was to offer insights and recommendations concerning the content of the two consultation rounds and to evaluate the suitability of each aspect independently. The assessments provided by expert panel members were submitted anonymously, ensuring confidentiality. Their participation was entirely voluntary, and they provided informed consent without receiving any compensation. To finalize the evaluation system, the research group integrated the various categories and components based on the expert opinions. Consequently, the authority of the final evaluation system was determined based on the input, opinions, and recommendations of the expert panel.

2.4.2. Questionnaire development

The research questionnaire was structured into three sections: an introductory section, the core content of the questionnaire, and the experts' basic information. Firstly, the questionnaire's introduction provided context, elucidating the study's background, purpose, and significance. Secondly, the main body of the questionnaire

presented each evaluation indicator along with a method for assessing the importance of each item. The experts were tasked with rating each item on a Likert scale ranging from 1 to 5, where 5 represented the highest significance. Additionally, they were encouraged to offer comments and propose additional items. Lastly, the experts' basic information encompassed details such as age, educational background, years of experience in medical education, professional position, professional title, familiarity with the indicators (Cs), and the rationale underpinning their judgments (Ca).

2.4.3. Expert consultation procedure

Two rounds of Delphi consultation were conducted via e-mail, and the experts were given a two-week window to respond after receiving the questionnaire. In the first round, the results were collected, numbered, sorted, and categorized for subsequent discussion. The questionnaire for the second round was designed through group discussions and revisions, taking into account relevant literature and standards. After two rounds of consultation, consensus was achieved among the experts, concluding the consultation process.

2.5. Research and ethics approval

Ethical approval for this study was granted by the Ethics Committee of Tianjin Medical University (Reference Number: TMuhMEC2023062). All expert participants were anonymized throughout the research process, and data were collected solely for scholarly purposes. Participants were formally invited via email, and explicit informed consent was obtained from each contributor, ensuring their voluntary participation and understanding of the study's objectives.

2.6. Data analysis

Data analysis was conducted using SPSS version 22.0, with the response rate of the questionnaire used as a metric to assess the level of expert engagement. The degree of authority among experts was determined using the authority coefficient (Cr), which takes into account the expert's educational background, the basis for their judgments (Ca), and their familiarity with the indicators (Cs). Cr was computed using the formula Cr = (Ca + Cs) / 2, and the results were considered acceptable when Cr exceeded 0.7, as previously described [16]. The degree of expert opinion concentration was evaluated using the mean and standard deviation of item importance scores. Consistency in expert opinions was assessed through the coefficient of variation (CV). A consensus was deemed to exist when the mean importance score reached 3.5 or higher, the coefficient of variance was less than 25%, and at least 80% of experts gave an item 5 points. Each indicator's weight was determined using AHP, and the geometric mean method was chosen to calculate the weight value. In regard to consistency testing, consistency index (C.I.) and average random consistency index (R.I.) were used, and the ratio of C.I. and R.I. was considered the consistency ratio (C.R.) [17]. A judgment matrix was considered to have a satisfactory weight distribution when the C.R. was less than 0.10, indicating satisfactory consistency.

3. Results

3.1. Enthusiasm and authority of experts

In this study, we conducted two rounds of expert consultation with 15 experts from 12 major cities, including Beijing, Shanghai, Tianjin, Wuhan, Chengdu, Nanjing, Changsha, Xiamen, Hangzhou, Taiyuan, and Xi'an. The first round of the Delphi process yielded 11 complete responses, resulting in a response rate of 73.33%,

while the second round involved 15 expert panelists, achieving a recovery rate of 100.00%. The Ca values for the two rounds were 0.927 and 0.942, with Cs values of 0.982 and 0.900. The resulting Cr values were 0.955 and 0.921, indicating a high level of expert authority, in line with established criteria.

3.2. Degree of coordination and concentration

Kendall's W and the chi-square test were employed to assess the degree of coordination among expert opinions. Kendall's W yields values within the range of 0 to 1, with higher values indicating greater consensus and improved item coordination. Due to the limited number of first-level indicators (fewer than 7), only second and third-level indicators were analyzed. In the first round of expert consultation, Kendall's W values for the second and third levels were 0.143 and 0.240, respectively. In the second round, these values were 0.174 and 0.238. Additionally, the chi-square test indicated statistically significant differences ($p < 0.05$), indicating that the results were acceptable [16].

Next, the importance value and coefficient of variance were used to analyze the degree of concentration of expert opinions. The results showed that the degree of expert opinion concentration was better for higher importance assignments and smaller CV values. In this study, expert consultation resulted in mean importance scores ranging from 3.64 to 5.00 for each indicator and CV values ranging from 0 to 0.245, indicating a relatively high level of consensus and general agreement among the experts [16].

3.3. Results of expert consultation

In the first round, we observed a 90.3% expert agreement rate, with 6 experts making 20 recommendations, among which 7 were accepted (adoption rate, 35.0%). In the second round, the agreement rate increased to 94.4%, with 7 experts providing 35 recommendations (adoption rate, 34.3%). The final indicator system comprises 3 first-level indicators, 6 second-level indicators, and 71 third-level indicators. Additional details of the expert consultation can be found in **Table 2**.

Table 2. The results of the two rounds of expert consultation are summarized

	Structure		Process		Outcome		All	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Second-level	2	2	3	3	1	1	6	6
Third-level	30	26	34	36	8	9	72	71
Expert opinions	10	13	9	18	1	4	20	35
Amendments	7	9	4	9	1	0	12	18
Additions	1	3	1	9	0	4	2	16
Deletions	2	1	4	0	0	0	6	1
Adopt opinions	6	5	1	6	0	1	7	12
Adoption rate (%)	60.0	38.5	11.1	33.3	0	25.0	35.0	34.3

3.4.Weight distribution of the quality evaluation system

According to the principles of AHP, the evaluation index system for medical MOOC construction quality was organized into 4 hierarchical levels. We constructed multiple judgment matrices to assess the consistency of each first-level indicator, and the findings revealed that all CI and CR values were less than 0.1. As shown in **Table 3**, this confirms the absence of logical errors in the determination of first-level indicator weights and

highlights the consistency of judgments. Furthermore, we derived the weight coefficients for each indicator, which are presented in **Table 4**.

Table 3. The result of the consistency test of the second-level indicators

Indicators	CI	CR
Platform technique	0.030	0.020
Curriculum management	0.057	0.036
Team of teachers	0.073	0.047
Course content	0.045	0.029
Student participation	0.046	0.032
Student achievement	0.023	0.016

Table 4. Importance of assignment and weight of the medical MOOC construction quality evaluation system

Indicators content	Mean (SD)	CV	Weight	Combination weight
1 Structure			0.250	-
1.1 Platform technique	4.40 ± 0.63	0.144	0.250	0.063
1.1.1 The MOOC platform interface style is unified, concise, and elegant	4.13 ± 0.92	0.222	0.046	0.003
1.1.2 The MOOC platform interface has a navigation design that is straightforward to use	4.20 ± 0.68	0.161	0.061	0.004
1.1.3 The MOOC platform offers operating instructions and answers to common questions	4.00 ± 0.63	0.158	0.033	0.002
1.1.4 The video image is steady and clear, the composition is appropriate, and the sound quality is excellent	4.73 ± 0.46	0.097	0.208	0.013
1.1.5 The video has accurate subtitles	4.33 ± 0.62	0.142	0.084	0.005
1.1.6 Multiple play functions are available in the video, such as full-screen, double-speed, pause, and repeat	4.53 ± 0.83	0.184	0.145	0.009
1.1.7 The video has the function of keeping records of the keywords used, facilitating medical students to retrieve related information	4.13 ± 0.83	0.202	0.046	0.003
1.1.8 A search function is available on the course platform to assist medical students in finding learning resources	4.13 ± 0.99	0.240	0.046	0.003
1.1.9 The MOOC platform has a good operation response and can meet the needs of a large number of medical students to visit at the same time	4.73 ± 0.46	0.097	0.208	0.013
1.1.10 The MOOC platform has extensive administration capabilities and can monitor and analyze the learning process	4.50 ± 0.84	0.186	0.123	0.008
1.2 Curriculum management	4.73 ± 0.46	0.097	0.750	0.173
1.2.1 In curricular development, there is a complete testing procedure	4.40 ± 0.74	0.168	0.079	0.014
1.2.2 Invite medical students to participate in the MOOC's development and testing	4.13 ± 0.74	0.180	0.037	0.006
1.2.3 MOOC construction and administration are aided by adequate funding and personnel	4.87 ± 0.35	0.072	0.175	0.030
1.2.4 The course group holds regular teaching meetings	4.33 ± 0.62	0.142	0.061	0.011
1.2.5 The duration of the MOOC is reasonable, typically from 4 to 8 weeks	3.87 ± 0.92	0.236	0.020	0.004

1.2.6 Selection of those with high academic attainments and rich teaching experience to work as course lecturers	4.47 ± 0.64	0.143	0.093	0.016
1.2.7 There are periodic tests in the course	4.20 ± 0.94	0.224	0.048	0.008
1.2.8 There are teaching activities interspersed in the video, such as quizzes, surveys, reflection questions, and so on	3.64 ± 0.75	0.205	0.014	0.002
1.2.9 The course provides expanded learning resources, such as texts, books, links, etc.	3.93 ± 0.83	0.211	0.025	0.004
1.2.10 Course notifications are sent in various ways, including the platform, e-mail, and SMS	4.20 ± 0.78	0.185	0.048	0.008
1.2.11 Teachers and students have established interactive discussion forums, such as QQ, WeChat, etc.	3.73 ± 0.84	0.237	0.017	0.003
1.2.12 The course includes peer or self-evaluation as well as comprehensive grading standards	3.93 ± 0.96	0.245	0.025	0.004
1.2.13 The assessment of the course grade is reasonable and proportionate	4.13 ± 0.64	0.155	0.037	0.006
1.2.14 Certificates or degrees are provided according to the process evaluation and the final evaluation	4.33 ± 0.72	0.167	0.061	0.011
1.2.15 The course is periodically evaluated and revised to reflect the most recent developments in medical knowledge	4.60 ± 0.51	0.110	0.112	0.019
1.2.16 The feedback from students can be used to review or improve the course	4.73 ± 0.46	0.097	0.149	0.026
2 Process			0.644	-
2.1 Teaching staff	4.80 ± 0.41	0.086	0.297	0.219
2.1.1 The teacher faces the camera naturally	4.40 ± 0.74	0.168	0.037	0.008
2.1.2 The language used by the teacher is standardized and clear, with a suitable speaking tone and speed	4.47 ± 0.74	0.166	0.051	0.011
2.1.3 Teachers can effectively organize online discussions and interactions	4.47 ± 0.64	0.143	0.051	0.011
2.1.4 The teachers' teaching schedule is reasonable, and the teaching tasks can be completed on time	4.40 ± 0.51	0.115	0.038	0.008
2.1.5 The teaching method matches the content of MOOCs	4.80 ± 0.41	0.086	0.125	0.027
2.1.6 The organization of the MOOC content is logical, and the knowledge point arrangement is reasonable	4.93 ± 0.26	0.052	0.148	0.032
2.1.7 The medical knowledge taught by the teachers is up-to-date, cutting-edge, and practically applicable	4.47 ± 0.52	0.115	0.051	0.011
2.1.8 The medical knowledge taught by the teachers can meet students' learning needs	5.00 ± 0.00	0.000	0.184	0.040
2.1.9 Teachers focus on the intersection of knowledge in different subjects	4.60 ± 0.51	0.097	0.077	0.017
2.1.10 Teachers attach importance to imparting knowledge and educating people	4.73 ± 0.46	0.086	0.105	0.023
2.1.11 Teachers reply and organize valuable posts in a timely manner	4.27 ± 0.70	0.165	0.034	0.007
2.1.12 Teachers promptly correct students' papers, provide feedback, and answer inquiries	4.20 ± 0.78	0.185	0.024	0.005
2.1.13 Teachers organize MOOC-related offline activities	3.93 ± 0.96	0.245	0.016	0.004
2.1.14 The teacher's assessment of students is clear, fair, and effective	4.53 ± 0.74	0.164	0.058	0.013
2.2 Course content	4.93 ± 0.26	0.052	0.540	0.331

2.2.1 The course provides an introduction to the teachers or teaching team	4.60 ± 0.63	0.137	0.083	0.028
2.2.2 The course introduces the primary teaching content and objectives	4.67 ± 0.49	0.104	0.105	0.035
2.2.3 The assessment method and credit certification are clearly stated in the course	4.87 ± 0.35	0.072	0.165	0.054
2.2.4 The chapter's learning objectives are listed in the course and are measurable	4.53 ± 0.74	0.164	0.067	0.022
2.2.5 The video length of each knowledge point is appropriate, ranging from 5 to 10 minutes	4.40 ± 0.63	0.144	0.045	0.015
2.2.6 The course's extended learning materials are accessible and can meet students' learning needs	4.33 ± 0.62	0.142	0.033	0.011
2.2.7 Detailed rules are set to tutor student participation in course discussions.	4.47 ± 0.64	0.143	0.059	0.019
2.2.8 The course provides detailed assignment and examination requirements, such as starting and ending times	4.80 ± 0.41	0.086	0.128	0.042
2.2.9 The course can help students develop their cognitive abilities, experimental operation abilities, and clinical thinking abilities	4.47 ± 0.52	0.115	0.057	0.019
2.2.10 The course content can assist students in enhancing their self-learning ability	4.87 ± 0.35	0.072	0.160	0.054
2.2.11 The course content can assist students in enhancing their ability to cooperate	4.33 ± 0.52	0.119	0.033	0.011
2.2.12 The course content and delivery take into account the diversity of cultural values	4.40 ± 0.74	0.168	0.045	0.015
2.2.13 Regardless of cultural background, everyone can understand the examples in the course	4.07 ± 0.70	0.173	0.020	0.007
2.3 Student participation	4.60 ± 0.63	0.137	0.163	0.107
2.3.1 Students can watch MOOCs in full and on time	4.67 ± 0.62	0.132	0.201	0.022
2.3.2 Students watch the MOOCs with an earnest and attentive attitude	4.33 ± 0.82	0.188	0.061	0.007
2.3.3 Students can complete homework and unit tests on time	4.60 ± 0.63	0.137	0.141	0.015
2.3.4 Students completed homework and unit tests with good quality	4.60 ± 0.51	0.110	0.164	0.018
2.3.5 Students can carefully review the courseware or extended learning materials	4.47 ± 0.83	0.187	0.104	0.011
2.3.6 Students can evaluate each other based on the real situation of their classmates	4.40 ± 0.74	0.168	0.078	0.008
2.3.7 While viewing MOOCs, students can actively engage with teachers or classmates online	4.20 ± 0.86	0.205	0.048	0.005
2.3.8 Students can participate actively in the interaction of posts on the course platform	4.67 ± 0.49	0.104	0.172	0.018
2.3.9 Students can actively participate in off-platform discussion groups (such as QQ, WeChat, etc.)	4.07 ± 0.80	0.196	0.033	0.004
3 Outcome			0.107	-
3.1 Student achievement	4.60 ± 0.51	0.110	1.000	0.107
3.1.1 The final grade of the course (background data: the score of students)	4.53 ± 0.64	0.167	0.061	0.007
3.1.2 Course completion rate (the percentage of students who finished the MOOC of all the students who registered in it)	4.33 ± 0.72	0.086	0.041	0.004
3.1.3 Students master the knowledge of the course	4.80 ± 0.41	0.093	0.194	0.021

3.1.4 The students' clinical thinking ability has been improved	4.80 ± 0.45	0.097	0.194	0.021
3.1.5 The students' self-learning ability has been improved	4.73 ± 0.46	0.126	0.120	0.013
3.1.6 The students' independent thinking ability has been improved	4.73 ± 0.59	0.126	0.120	0.013
3.1.7 The students' ability to analyze and solve practical problems has been improved	4.73 ± 0.59	0.137	0.120	0.013
3.1.8 The students' critical thinking ability has been improved	4.60 ± 0.63	0.141	0.089	0.010
3.1.9 The students' cooperation ability has been improved	4.53 ± 0.64	0.110	0.061	0.007

4. Discussion

4.1. Reliability and scientific analysis

The Medical MOOC construction quality evaluation indicator system developed in this study is both scientifically sound and reliable. Firstly, it is based on the well-established theoretical framework of the Structure-Process-Outcome quality structure. Empirical evidence attests to the maturity of this theory in formulating evaluation indicators for medical teaching quality [15,18]. Additionally, the quality evaluation indicator system is meticulously crafted through a comprehensive literature review and subsequent refinement via two rounds of the Delphi method. Secondly, the credibility of the research findings is supported by the expertise and representativeness of the participating experts [16]. In this study, 15 experts were included from distinct regions across China, each recognized for their outstanding contributions and influence in medical education and MOOC construction. These experts provided invaluable insights and recommendations, demonstrating a remarkable degree of consensus and authoritative perspectives, and the outcomes of this research can be considered highly dependable [16].

4.2. Systematic and weight analysis

The medical MOOC construction quality evaluation indicator system developed in this study includes a comprehensive and systematic range of criteria. This approach aligns with Yang's perspective, emphasizing that e-learning evaluation should extend beyond assessing students' learning to include the evaluation of the e-learning environment, which encompasses the learning support platform, as well as the evaluation of learning resources [10]. A thorough analysis of these indicators, based on the "Structure-Process-Outcome" three-dimensional quality model, is provided below.

The structure indicator serves as the foundation of the course and is essential for the effective progression of medical MOOC teaching. This indicator comprises two components: platform technique and curriculum management. Our study results indicate that "curriculum management" (weighted at 0.750) carries greater significance than "platform technique" (weighted at 0.250). While "platform technique" does contribute to MOOC quality by influencing aspects such as interface design and personalized support, which directly impact students' learning experiences, "curriculum management" encompasses critical functions such as development and testing, organization and operation, and feedback and improvement [19]. Exceptional management of MOOCs is pivotal in attracting students and enhancing MOOC completion rates [20]. Therefore, "curriculum management" has been assigned a higher weight due to its greater impact on overall effectiveness. To ensure the smooth progression of Medical MOOC teaching, it is imperative to implement standardized and scientifically driven curriculum management, aligning with the objective of nurturing talent

[10,21]. Among the third-level indicators, "MOOC construction and administration are aided by adequate funding and personnel (0.030)" holds the highest combination weight, consistent with findings by King [22]. Unlike traditional programs and courses, MOOCs heavily rely on information technology and online platforms, involving not only instructors but also video producers, web designers, and web admins, among others. Therefore, sufficient human and financial support serves as a crucial foundation for structural factors. Moreover, traditional courses often entail more face-to-face interaction between teachers and students, enabling instructors to gather feedback through performance assessment and post-class communication. In contrast, MOOCs feature limited direct interaction between instructors and students, emphasizing the importance of timely feedback collection and adjustments in course quality evaluation. Consequently, "the feedback from students can be used to review or improve the course (0.026)" and "the course is periodically evaluated and revised to reflect the most recent developments in medical knowledge (0.019)" also carry significant combination weights.

The process indicator refers to the course construction and teaching implementation processes of medical MOOCs, covering teaching staff, course content, and student participation, which offer valuable insights into educational quality. Among the second-level indicators, "Course content (0.540)" had the highest weight and included course and teacher introductions, course outlines, learning objectives, and assessment methods [21]. All these elements collectively constitute the most critical components of MOOC content. In contrast, "student participation (0.163)" had the lowest weight. While learner engagement can somewhat reflect MOOC quality by increasing user numbers and fostering discussions, it is essential to acknowledge that learners' commitment levels may vary. Some learners may engage selectively, focusing on specific chapters or initial course content, engaging in partial learning without intending to complete the entire medical MOOC [21]. Therefore, compared to "course content" and "teaching staff", the quality of medical MOOC construction should not overly depend on students' performance in the course. Among the third-level indicators, both "The assessment method and credit certification are clearly stated in the course" and "The course content can assist students in enhancing their self-learning ability" hold the highest combination weight of 0.054 each. Course assessment serves as a crucial tool for measuring learning outcomes, evaluating the achievement of teaching objectives, and assessing teaching quality. The results of assessments play a pivotal role in guiding teachers in designing effective teaching strategies [23]. Simultaneously, granting credits for MOOC scores provides positive incentives for students, fostering their motivation to learn [24,25]. Credit recognition is also a significant factor for students when selecting courses. Furthermore, MOOCs necessitate students to develop strong self-regulated learning abilities. Therefore, it is essential to adopt a student-centered and content-oriented approach that encourages active and continuous learning among students.

In the context of this study, the outcome indicator reflects the impact of curriculum construction, specifically through the second-level indicator "student achievement". Within the third-level indicators, both "Students master the knowledge of the course" and "The students' clinical thinking ability has been improved" hold the highest combined weight, both at 0.021. Clinical thinking ability pertains to a doctor's capacity to make sound decisions based on real patient scenarios during patient care [26]. Developing the clinical thinking abilities of medical students within the classroom setting is crucial for their future clinical work. Among the third-level indicators in this category, "course completion rate" has the lowest combined weight at 0.004, followed by "the final grade of the course" at 0.007. Unlike traditional teaching methods, MOOC learners often possess diverse backgrounds and characteristics. One study suggests that when evaluating MOOC quality, the non-compulsory nature of MOOCs should be considered [21]. In this context,

the quality of a MOOC is closely tied to individual student goals. Therefore, a MOOC can be considered of high quality if students have achieved their desired learning outcomes, even if they did not complete the entire course. Consequently, traditional metrics like completion rates may not be the most suitable quality indicators [7,20]. Furthermore, examination questions that assess overall achievement in medical MOOCs are typically objective, which can limit the assessment of students' subjectivity, initiative, and creativity. Consequently, it becomes more important to evaluate whether specific skills and learning abilities of students have been effectively enhanced rather than solely relying on course completion rates and overall achievement. This approach aligns with recent trends in Chinese medical education, which emphasize a shift towards "focusing more on competency and quality development" rather than a sole focus on knowledge transfer [27].

4.3. The effectiveness of combining the Delphi and AHP methods

In this present research study, a combination of the Delphi and AHP methods were applied to establish the evaluation index system for assessing the quality of Medical MOOC construction and to validate the weight coefficients assigned to each indicator. The Delphi technique, a well-established method for gathering diverse expert opinions and achieving consensus in a particular field of discussion, was utilized to develop the initial index system. The results obtained through the generalized Delphi method in this study were found to be highly accurate and reliable. In addition to the Delphi method, we incorporated the AHP, which quantifies experts' subjective judgments using mathematical models, facilitating a structured and scientific approach to multi-objective decision-making analysis [17]. The use of Saaty's scale for assigning significance greatly simplifies the process of expert judgment. Since our quality index system encompasses all facets and stages of medical MOOC teaching, the experts used a pairwise comparison matrix to determine the relative importance of each indicator. The results demonstrated that the consistency of all the indexes was confirmed through a consistency test, with a CR less than 0.10, indicating that the logical consistency was well-maintained, ensuring both scientific rigor and reliability. The quality index system for evaluating the construction of Medical MOOCs, developed through this combination of the Delphi and AHP methods, reflects the expertise of specialists and the precision of quantified assessment. A study that explored the efficacy of combining Delphi and AHP methods in developing evaluation systems found that this approach enhanced the reliability and validity of expert assessments, clarifying the qualifications required [28]. In summary, the quality index system we have established for evaluating the construction of Medical MOOCs, along with the assigned weight coefficients, can be considered scientifically sound, reliable, and practical.

5. Limitations

This study had several limitations that should be considered. First, due to resource and time constraints, we were only able to invite 15 experts to participate in the Delphi survey. While there is no consensus on the optimal panel size for a Delphi study, a systematic review by Paré [29]. suggested a typical range of 7 to 30 participants. Although our study falls within this range regarding panel size per round, it is important to note that we experienced a decline in the expert response rate, particularly in the first round, where the effective response rate was 73.33% (n = 11), which is slightly higher than the recommended threshold of 70% [30]. It is worth acknowledging that a drop in response rates is a common challenge encountered in e-Delphi studies [31].

Assessing the potential impact of attrition bias on the quality and credibility of our findings is a complex task. As the number of participants diminishes in subsequent rounds, there is a risk of overestimating the degree of consensus. Another limitation relates to the potential bias in our selection of experts. Most of the participating experts were from regions in China recognized for their robust evidence-based education, and this regional bias may affect the generalizability of our results. Furthermore, it is essential to emphasize that the indicator system developed in this study has not undergone validation, reliability testing, or empirical application. Therefore, this study recommends that future research include comprehensive quantitative evaluations of all indicators to enhance the effectiveness of medical MOOC teaching. We also propose conducting empirical studies on selected medical MOOCs using comprehensive fuzzy evaluation methods to further analyze and improve the applicability of this indicator system [30].

6. Conclusion

This study adopted a three-dimensional quality evaluation model as its theoretical framework and leveraged the Delphi method, drawing extensively from existing literature, to construct an evaluation indicator system for assessing the quality of medical MOOC construction, which ensured the scientific validity and credibility of the constructed system. The resultant evaluation indicator system comprises three primary indices, six secondary indices, and 71 tertiary indices. Furthermore, the study benefited from the expertise, motivation, and cooperation of the participating experts, reinforcing the scientific foundation of the medical MOOC construction quality evaluation index system. The AHP was employed to determine the weighted values across all levels of the quality index, which were established based on experts' assessments using Saaty's scale, and the consistency ratio was found to be less than 0.10, indicating the reliability of the weight coefficients. The analysis of the weighted values within the index system revealed that both course content and teaching staff significantly influence the quality of medical MOOC construction. Additionally, effective curriculum management practices contribute to the enhancement of medical MOOC teaching quality. Specifically, the combination of well-designed course content and efficient teacher management serves as the cornerstone for achieving high-quality medical MOOC teaching. In summary, the proposed indicator system in this present study provides a valuable and practical tool for continuously enhancing the quality of medical MOOCs in China.

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References

[1] Williams R, 2024, An Overview of MOOCs and Blended Learning: Integrating MOOC Technologies Into Traditional Classes. IETE Journal of Education, 65(2): 84–91.

[2] Ahmad I, Sharma S, Singh R, et al., 2022, MOOC 5.0: A Roadmap to the Future of Learning. Sustainability, 14(18): 11199.

[3] Pichayakul P, 2024, Academic Outreach During COVID-19 Lockdown at a University Level: Using MOOC as a Strategy. Journal of Education and Innovation, 26(3): 86–99.

[4] Guo Y, 2014, MOOCs and the Future of China's Higher Education. Journal of Higher Education Management, 5: 29–33.

[5] People's Daily, 2023, Technology-Enabled Education Shares University Resources, visited on 2026/6/11,http://www.moe.gov.cn/jyb_xwfb/xw_zt/moe_357/2023/2023_zt01/mtbd/202302/t20230212_1043924.html.

[6] Zhu H, Xu J, Wang P, et al., 2023, The Irreplaceable Role of Medical Massive Open Online Courses in China During the COVID-19 Pandemic. BMC Medical Education, 23(1): 323.

[7] Huang H, Jew L, Qi D, 2023, Take a MOOC and Then Drop: A Systematic Review of MOOC Engagement Pattern and Dropout Factor. Heliyon, 9(4): e15220.

[8] Celik B, Cagiltay K, 2024, Uncovering MOOC Completion: A Comparative Study of Completion Rates From Different Perspectives. Open Praxis, 16(3): 445–456.

[9] Zhou L, Tang M, Liu J, 2025, Analysis of Factors Influencing MOOC Quality Based on I-DEMATEL-ISM Method. Systems and Soft Computing, 7: 200220.

[10] Yang L, Zou J, Gao J, et al., 2023, Assessing the Effectiveness of Massive Open Online Courses on Improving Clinical Skills in Medical Education in China: A Meta-Analysis. Heliyon, 9(8): e19263.

[11] Cheng J, Yuen K, Chiu W, 2023, Systematic Review of MOOC Research in Mainland China. Library Hi Tech, 41(5): 1476–1497.

[12] Jain R, 2023, Premchand's The Chess Players: A Comparative Analysis of YouTube and MOOC Platforms. New Literaria, 4(1): 45–52.

[13] Ponnaiah M, Bhatnagar T, Ganeshkumar P, et al., 2022, Design and Implementation Challenges of Massive Open Online Course on Research Methods for Indian Medical Postgraduates and Teachers – Descriptive Analysis of Inaugural Cycle. BMC Medical Education, 22(1): 369.

[14] Shang Z, 2023, Use of Delphi in Health Sciences Research: A Narrative Review. Medicine, 102(7): e32829.

[15] Robby A, Nurjazuli N, Izzah L, et al., 2025, From Structure to Outcome: The Role of the Donabedian Model in Global Health Service Management Research (1987–2024). E3S Web of Conferences, 650: 02025.

[16] Hsu C, Sandford A, 2007, The Delphi Technique: Making Sense of Consensus. Practical Assessment, Research and Evaluation, 12(1): 10.

[17] Saaty L, 1990, How to Make a Decision: The Analytic Hierarchy Process. European Journal of Operational Research, 48(1): 9–26.

[18] Kelly L, Whitaker A, Burchinal M, et al., 2026, Testing the Structure–Process–Outcome Model Across Different Early Care and Education Policy Contexts. Developmental Psychology, 62(2): 442–461.

[19] Chen H, 2023, Influencing Factors of the Quality of MOOCs Based on the KANO Model. International Journal of Emerging Technologies in Learning, 18(17): 20–32.

[20] Mehrabi M, Safarpour R, Keshtkar A, 2022, Massive Open Online Courses (MOOCs) Dropout Rate in the World: A Protocol for Systematic Review and Meta-Analysis. Interdisciplinary Journal of Virtual Learning in Medical

Sciences, 13(2): 85–92.

[21] Hendriks A, de Jong M, Admiraal F, et al., 2020, Instructional Design Quality in Medical Massive Open Online Courses for Integration Into Campus Education. Medical Teacher, 42(2): 156–163.

[22] King I, Lee I, 2023, MOOC Policies Across the Globe. In: King I, Lee W I (eds.) A Decade of MOOCs and Beyond. Springer International Publishing: 61–88.

[23] Liu X, Feng J, Liu C, et al., 2023, Medical Education Systems in China: Development, Status, and Evaluation. Academic Medicine, 98(1): 43–49.

[24] Moore R, Blackmon S, 2022, From the Learner's Perspective: A Systematic Review of MOOC Learner Experiences (2008–2021). Computers & Education, 190: 104596.

[25] Oo S, Schofield S, Aung T, et al., 2022, Integrating a Mobile-Learning Platform for Enhancing Clinical Teaching: The Learners' Perspective. International Journal of Learning, Teaching and Educational Research, 21(11): 87–111.

[26] Hui Z, Zewu Z, Jiao H, et al., 2025, Application of ChatGPT-Assisted Problem-Based Learning Teaching Method in Clinical Medical Education. BMC Medical Education, 25(1): 50.

[27] Sun H, Chen H, Dong C, et al., 2021, Building a First-Class Nursing Major With National Standards for Nursing Teaching Quality. Chinese Journal of Nursing Education, 18(5): 389–394.

[28] Meng Q, Wang F, Chen K, et al., 2026, Development and Evaluation of an Evidence-Based Management Indicator System for Transitional Care in Preterm Infants Using a Delphi and AHP Approach. Journal of Nursing Management, 2026(1): 2638144.

[29] Paré G, Cameron F, Poba-Nzaou P, et al., 2013, A Systematic Assessment of Rigor in Information Systems Ranking-Type Delphi Studies. Information & Management, 50(5): 207–217.

[30] Hayes B, Fitzgerald D, Doherty S, et al., 2015, Quality Care, Public Perception and Quick-Fix Service Management: A Delphi Study on Stressors of Hospital Doctors in Ireland. BMJ Open, 5(12): e009564.

[31] Donohoe H, Stellefson M, Tennant B, 2012, Advantages and Limitations of the e-Delphi Technique: Implications for Health Education Researchers. American Journal of Health Education, 43(1): 38–46.

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Clinical Applications of AI-Based Fetal Monitoring in Labor Management and Its Impact on Maternal and Neonatal Outcomes

Yeqing Su

Department of Obstetrics, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

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Abstract: *Objective*: To investigate the clinical application of AI-based labor monitoring in labor management and its impact on maternal and fetal outcomes. *Methods*: A total of 240 pregnant women scheduled for vaginal trial of labor admitted to our hospital from January 2024 to June 2025 were selected as study subjects. They were randomly divided into a control group and an observation group, each comprising 120 cases. The control group underwent traditional manual timed monitoring, while the observation group received AI-based labor monitoring. This study compared the duration of each stage of labor, mode of delivery, incidence of related complications, and rate of neonatal adverse events between the two groups, and evaluated the accuracy of identifying abnormal labor patterns and differences in healthcare workload. *Results*: The duration of the first and second stages of labor, as well as the total duration of labor, was significantly shorter in the observation group than in the control group; the incidence of cesarean sections without medical indications, postpartum hemorrhage, and puerperal infections was significantly lower in the observation group than in the control group ($p < 0.05$); the incidence of meconium-stained amniotic fluid, mild asphyxia, and neonatal intensive care unit admission rates were all lower in the observation group than in the control group ($p < 0.05$); the observation group had lower rates of missed or misdiagnosed labor abnormalities, and the workload associated with medical documentation and repetitive monitoring was significantly reduced ($p < 0.05$). *Conclusion*: The AI-based labor monitoring system enables comprehensive, continuous, and precise management throughout labor, effectively accelerating labor progression, avoiding overtreatment, and reducing the risk of adverse maternal and neonatal complications. It also optimizes obstetric workflows and enhances the standardization of diagnosis and treatment, demonstrating promising prospects for clinical implementation.

Keywords: Artificial intelligence; Labor monitoring; Labor management; Maternal and neonatal outcomes; Smart obstetrics; Precision medicine

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1. Introduction

Vaginal delivery is the primary method of natural childbirth; however, the labor process is dynamic and

variable, with significant individual differences. The progression of labor is highly susceptible to interference from multiple factors, such as uterine contractions, the birth canal, fetal position, fetal condition, and the mother's psychological state. This can easily lead to labor abnormalities and intrauterine hypoxia. If not promptly identified and effectively intervened upon, it can readily trigger adverse events such as labor arrest, dystocia, postpartum hemorrhage, and neonatal hypoxic injury. Therefore, it is essential to establish a precise, continuous, and efficient labor monitoring system to achieve the goals of reducing perinatal risks and improving birth outcomes [1].

Traditional labor management models rely heavily on healthcare providers conducting scheduled physical examinations, intermittent data recording, and experience-based interpretation. These approaches suffer from inherent flaws, including fixed monitoring intervals, fragmented data, delayed recording, and significant subjective bias. Furthermore, influenced by factors such as staffing levels, night shifts, and work fatigue, manual monitoring is highly prone to missing or misinterpreting early abnormalities, which can lead to delayed or excessive interventions, resulting in prolonged labor and an increase in unnecessary cesarean sections [2]. As the digital transformation of smart healthcare continues to advance, technologies such as artificial intelligence, deep learning, multi-source data fusion, and intelligent risk prediction are gradually being integrated into obstetric clinical practice. Artificial intelligence-based labor monitoring systems can automatically capture multidimensional data, including uterine contraction patterns, fetal heart rate dynamics, cervical dilation, descent of the presenting part, and maternal vital signs, and use algorithmic models to perform real-time analysis, tiered alerts, and trend forecasting, effectively addressing the shortcomings of manual monitoring [3]. This study employs a prospective controlled design to systematically analyze the advantages of intelligent labor monitoring, providing a practical basis for establishing standardized, precise, and efficient smart labor management models in clinical practice.

2. Materials and methods

2.1. General information

A total of 240 full-term pregnant women scheduled for vaginal delivery at our hospital's obstetrics department between January 2024 and June 2025 were selected as study subjects and randomly divided into a control group and an observation group, each comprising 120 cases. The observation group consisted of women aged 22–35 years (mean 28.63 ± 3.12 years) with a gestational age of 39.25 ± 1.06 weeks; it included 98 primiparous women and 22 multiparous women; The control group ranged in age from 21 to 36 years, with a mean age of (28.41 ± 3.25) years and a gestational age of 39.18 ± 1.12 weeks; it included 96 primiparous women and 24 multiparous women. There were no statistically significant differences between the two groups in baseline age, gestational age, parity, or general physical condition ($p > 0.05$), and the groups were comparable.

2.1.1. Inclusion criteria

(1) Gestational age 37–42 weeks;
(2) Singleton pregnancy, cephalic presentation;
(3) Normal pelvic anatomy and eligibility for trial of labor;
(4) Normal cognitive function and ability to cooperate with continuous monitoring;
(5) Complete clinical records

2.1.2. Exclusion criteria

(1) Cesarean scar, abnormal fetal presentation, or cephalopelvic disproportion;
(2) High-risk pregnancies, including severe gestational hypertension, gestational diabetes, or placenta previa;
(3) Severe underlying cardiac, hepatic, or renal disease; fetal growth restriction or intrauterine malformations;
(4) Cases where trial labor was discontinued, patients were transferred to another hospital, or data were missing.

2.2. Study methods

2.2.1. Control group

Conventional labor management was employed. Medical staff conducted intermittent labor monitoring in accordance with obstetric clinical guidelines, regularly monitoring the intensity of uterine contractions, fetal heart rate, cervical dilation, and descent of the presenting part. They manually recorded labor progress, plotted labor curves, interpreted fetal heart rate monitoring tracings, and assessed labor progression based on clinical experience. Conventional symptomatic management was provided for abnormal labor conditions.

2.2.2. Observation group

In addition to routine obstetric care, an artificial intelligence-based labor monitoring system was used throughout the entire process to implement intelligent labor management.

(1) Continuous data collection was conducted around the clock; the system automatically and synchronously captured key indicators such as fetal heart rate dynamics, uterine contraction parameters, and maternal vital signs, enabling uninterrupted monitoring and eliminating blind spots and recording errors associated with manual monitoring intervals.
(2) Leveraging deep learning algorithms, the system performs intelligent analysis of fetal heart rate variability, uterine contraction rhythm consistency, and labor progression speed. It issues tiered alerts for abnormal conditions such as labor arrest, prolonged latent phase, and early fetal intrauterine hypoxia, prompting immediate clinical intervention.
(3) The system automatically generates dynamic labor progress curves and, by integrating the mother's individual baseline data, intelligently predicts labor trends to provide personalized guidance on the optimal timing for intervention.
(4) The system pushes standardized management protocols for various abnormal scenarios, unifies clinical intervention procedures, and reduces variability in subjective diagnosis and treatment. It also automatically archives data throughout the process, ensuring the delivery process is traceable and reviewable.

Medical staff combine intelligent alerts with clinical experience to implement comprehensive interventions, ensuring precise and standardized labor management.

2.3. Observation indicators

(1) Duration of labor

Calculate and compare the durations of the first, second, and third stages of labor, as well as the total duration of labor, between the two groups;

(2) Maternal outcomes

Record the incidence of cesarean sections, non-emergency cesarean sections, postpartum hemorrhage, puerperal infections, and cervical lacerations in both groups;

(3) Neonatal outcomes

Compare the incidence rates of meconium-stained amniotic fluid, mild neonatal asphyxia, and NICU admission;

(4) Quality of care and workload

Calculate the incidence of missed or misdiagnosed labor abnormalities; compare differences in the time spent on routine documentation and the workload associated with repetitive monitoring between the two groups.

2.4. Statistical methods

Data were analyzed using SPSS 26.0 statistical software. Continuous variables are expressed as mean ± standard deviation, and intergroup comparisons were performed using the independent samples *t*-test. Categorical variables are presented as counts and percentages, and the chi-square χ^2 test was used. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of labor duration between the two groups

Statistical results showed that the duration of the first stage, second stage, and total labor in the observation group was significantly shorter than that in the control group, with statistically significant differences between groups ($p < 0.05$); there was no significant difference in the duration of the third stage between the two groups ($p > 0.05$). See **Table 1** for details.

Table 1. Comparison of labor duration at each stage between the two groups ($\bar{x} \pm s$)

Group	First stage of labor	Second stage	Third stage of labor	Total labor
Observation group (n = 120)	426.35 ± 52.16	45.28 ± 10.36	6.85 ± 2.12	478.48 ± 56.32
Control group (n = 120)	512.68 ± 63.42	58.76 ± 12.15	7.12 ± 2.35	578.56 ± 68.45
t	11.517	9.248	0.935	12.368
p	< 0.001	< 0.001	0.351	< 0.001

3.2. Comparison of maternal delivery outcomes between the two groups

The overall cesarean section rate, the rate of cesarean sections without medical indication, and the incidence of postpartum hemorrhage and puerperal infection were all lower in the observation group than in the control group, with statistically significant differences ($p < 0.05$); the incidence of cervical lacerations was similar between the two groups, with no statistically significant difference ($p > 0.05$). See **Table 2** for details.

Table 2. Comparison of adverse maternal delivery outcomes between the two groups [n (%)]

Group	Cesarean section rate	Unindicated cesarean section rate	Postpartum hemorrhage	Puerperal infection	Cervical laceration
Observation group (n = 120)	12 (10.00)	4 (3.33)	3 (2.50)	2 (1.67)	5 (4.17)
Control group (n = 120)	25 (20.83)	13 (10.83)	10 (8.33)	8 (6.67)	7 (5.83)
χ^2	5.684	5.217	4.072	3.968	0.357
p	< 0.05	< 0.05	< 0.05	< 0.05	> 0.05

3.3. Comparison of neonatal outcomes between the two groups

The incidence of meconium-stained amniotic fluid, mild asphyxia, and NICU admission was significantly lower in the observation group than in the control group ($p < 0.05$); no cases of severe neonatal asphyxia were observed in either group. See **Table 3** for details.

Table 3. Comparison of neonatal outcomes between the two groups [n (%)]

Group	Meconium-stained amniotic fluid	Mild neonatal asphyxia	NICU admission rate
Observation group (n = 120)	6 (5.00)	2 (1.67)	3 (2.50)
Control group (n = 120)	15 (12.50)	9 (7.50)	11 (9.17)
χ^2	4.227	4.669	4.855
p	0.039	0.031	<0.028

3.4. Comparison of clinical quality and workload between the two groups

The observation group showed significantly lower rates of missed and misdiagnosed abnormal labor, significantly reduced time spent on routine documentation by medical staff, and a substantial decrease in repetitive workload; all differences between groups were statistically significant ($p < 0.05$). See **Table 4** for details.

Table 4. Comparison of clinical quality and workload between the two groups

Group	Rate of missed diagnosis of abnormal labor [n(%)]	Misdiagnosis rate of abnormal labor [n(%)]	Average daily documentation time ($\bar{x} \pm s$)
Observation group (n = 120)	1 (0.83)	2 (1.67)	2.15 ± 0.42
Control group (n = 120)	8 (6.67)	9 (7.50)	3.86 ± 0.65
/t	4.733	4.669	24.205
p-value	0.029	0.031	< 0.001

4. Discussion

In the safe management of vaginal delivery, the timely implementation of accurate and effective labor monitoring is a crucial measure for ensuring safe maternal and neonatal outcomes [4]. In the past, due to limited information technology, obstetric healthcare providers primarily relied on manual monitoring for women undergoing vaginal delivery. However, this method, which involved scheduled physical examinations and subjective interpretation, suffered from shortcomings such as sporadic monitoring points and delayed data updates. Consequently, it was difficult to capture subtle changes in labor dynamics, making it highly likely to delay intervention in the event of early abnormalities and hindering obstetric quality control [5].

With the continuous advancement of information technology, artificial intelligence (AI) labor monitoring systems, which leverage big data algorithms and real-time dynamic analysis capabilities, have been widely adopted in obstetric care, marking a breakthrough over traditional manual monitoring [6,7]. By integrating AI labor monitoring technology into labor management practices, this study found that its clinical application can significantly shorten the duration of labor, The analysis suggests that by continuously capturing dynamic fluctuations in uterine contraction patterns, fetal heart rate changes, and the rate of labor progression, the AI monitoring system can provide early warnings for issues such as labor failure, delayed progression, and early depletion of intrauterine reserve. This alerts healthcare providers to promptly implement targeted interventions, such as positional adjustments and oxytocin adjustments, thereby correcting abnormal labor and accelerating the natural delivery process [8]. This study also found that, compared to the control group, the observation group showed significantly lower overall cesarean section rates, rates of unindicated cesarean sections, and incidence of postpartum hemorrhage and puerperal infections ($p < 0.05$). The core mechanism lies in the fact that AI algorithms, trained on massive amounts of clinical data, can accurately distinguish between normal fluctuations and genuine intrauterine abnormalities, thereby maximizing improvements in maternal delivery outcomes; Regarding neonatal prognosis, labor management utilizing AI-based delivery monitoring technology can dynamically monitor the physiological status of pregnant women and newborns through intelligent systems, rapidly identify early signs of hypoxia, and buy time for healthcare providers to initiate emergency interventions, thereby reducing the risk of neonatal hypoxia, asphyxia, and admission to intensive care units [9]. From a hospital management perspective, AI monitoring technology uses relevant equipment and sensors to collect labor data, perform timely intelligent analysis, and archive records with a single click. This significantly simplifies administrative tasks for medical staff and alleviates their workload. At the same time, the AI system's standardized algorithm-based interpretation capabilities unify diagnostic and treatment standards, avoiding the diagnostic biases associated with reliance on individual experience, thereby effectively enhancing the standardization and consistency of labor management [10].

5. Conclusion

In summary, clinical labor management based on AI-driven delivery monitoring technology is an inevitable requirement for meeting the high standards of maternal and infant safety in the new era. By applying intelligent systems and AI algorithms, it enables dynamic, precise, controllable, and standardized fine-grained management throughout the entire delivery process. This significantly shortens the duration of labor, reduces excessive medical interventions, and lowers the incidence of maternal and infant complications, fundamentally addressing the shortcomings and limitations of traditional manual monitoring models. At the same time, AI monitoring technology, through automated data collection and intelligent analysis of labor progress data, can significantly reduce the workload of medical staff, demonstrating high clinical value and promising prospects for widespread adoption.

Disclosure statement

The author declares no conflict of interest.

References

[1] Obstetrics Group of the Obstetrics and Gynecology Branch, Chinese Medical Association; Perinatal Medicine Branch, Chinese Medical Association, 2023, Guidelines for the Prevention and Management of Postpartum Hemorrhage (2023). Chinese Journal of Obstetrics and Gynecology, 58(6): 401–409.

[2] Hadad S, Oberman M, Arie A, et al., 2021, Intrapartum ultrasound at the initiation of the active second stage of labor predicts spontaneous vaginal delivery. Am J Obstet Gynecol MFM, 3(1): 100249.

[3] Zhang P, Zhang Y, Wang Q, et al., 2025, Intrapartum Ultrasound Indicators for Predicting the Difficulty of Vacuum Extraction. Chinese Journal of Perinatal Medicine, 28(3): 194–202.

[4] Huang Y, 2024, The Clinical Value of Real-time Ultrasound Monitoring in Labor Assessment and Delivery. Journal of Rare and Rare Diseases, 31(7): 99–101.

[5] Shang X, 2024, Application of Artificial Intelligence in Intrapartum Fetal Heart Rate Monitoring, thesis, Guangzhou Medical University.

[6] Wu Y, 2023, Establishment and Validation of a Predictive Model for Vaginal Delivery Success Rates Based on Real-World Data, thesis, Sichuan University.

[7] Oberman M, Avrahami I, Lavi S, et al., 2023, Assessment of Labor Progress by Ultrasound vs Manual Examination: A Randomized Controlled Trial. Am J Obstet Gynecol MFM, 5(2): 100817.

[8] Lu Y, Li Z, Bai J, et al., 2026, Application and Prospects of Artificial Intelligence in Full-Term Obstetric Management. Chinese Journal of Practical Gynecology and Obstetrics, 42(1): 124–128.

[9] Yu L, Wang H, Zhou Y, et al., 2025, The Value of an Obstetric Intelligent Assistant in Predicting Postpartum Hemorrhage in Vaginal Deliveries. Chinese Journal of Perinatal Medicine, 28(10): 829–834.

[10] Wang Z, 2025, Research and Application of Intelligent Algorithms for the Full Lifecycle Health Management of Pregnant Women and Mothers, thesis, Sichuan University.

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Technological Innovation in Nasal Base Augmentation: From Material Selection to Surgical Approach

Gang Chen*

Department of Plastic Surgery, Jiangsu Shiermei Plastic and Aesthetic Hospital, Nanjing 210000, Jiangsu, China

***Corresponding author**: Gang Chen, 88388429@qq.com

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Abstract: *Objective:* Comprehensively review the latest progress of nasal base filling technology in materials science and surgical approaches, and provide personalized treatment strategies from the perspective of evidence-based medicine based on large sample clinical data. *Methods:* A retrospective analysis was conducted on the clinical data of 1268 patients who underwent nasal base filling surgery in our hospital from January 2018 to December 2025. These patients were divided into the hyaluronic acid group based on different filling materials, with 386 patients in this group. The autologous adipose stem cell gel group, also known as SVF-gel group, had 272 patients, the preformed expanded polytetrafluoroethylene group, also known as ePTFE group, had 315 patients, the autologous rib cartilage group had 214 patients, and the 3D-printed polyether ether ketone group, also known as PEEK group, had 81 patients. Compare the aesthetic effects, incidence of complications, and patient satisfaction of each group at 6, 12, and 24 months postoperatively. *Results:* All patients underwent a follow-up period of 6 to 84 months. At 24 months postoperatively, the aesthetic effect rate was 97.53% in the PEEK group, 92.52% in the rib cartilage group, 88.25% in the ePTFE group, 65.44% in the SVF-gel group, and 41.71% in the hyaluronic acid group. The overall incidence of complications was 3.70% in the PEEK group, 6.35% in the ePTFE group, 8.88% in the rib cartilage group, 12.13 % in the SVF-gel group, and 15.54% in the hyaluronic acid group. *Conclusion:* The 3D-printed PEEK prosthesis has the best long-term stability and the lowest incidence of complications when used for correcting severe bony nasal base depression. Standardized surgical procedures and personalized material approach matching strategies are key to improving surgical outcomes and reducing complications.

Keywords: Nasal base augmentation; 3D-printed PEEK; Autologous dermis; Surgical approach; Complication; Clinical study

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1. Introduction

The nasal base is a pivotal element in midface aesthetics, with its height and contour directly determining

facial three-dimensionality and youthfulness. Among East Asian populations, approximately 76.3% exhibit varying degrees of nasal base depression, primarily caused by underdevelopment of the maxilla, leading to deepened nasolabial folds, reduced nasolabial angles, flattened midface, and protruding mouth appearance [1]. Since Millard first reported nasal base augmentation in 1988, this technique has become an integral part of facial rejuvenation surgery [2]. Early nasal base augmentation primarily employed silicone implants and autologous fat injection; however, issues such as relatively high implant displacement rates (15–20%), significant material absorption, and unnatural contours were observed [3]. Over the past five years, advancements in facial fine anatomy, breakthroughs in biomaterials science, and the widespread adoption of digital surgical techniques have significantly advanced nasal base augmentation technology [4]. Nevertheless, challenges persist in clinical practice, including material selection confusion, non-standardized surgical approaches, and overfilling [5]. Drawing on the author's 20 years of clinical experience and data from 1,268 cases, this article explores technological innovations in nasal base augmentation materials and surgical approaches, aiming to provide evidence-based medical guidance for standardized clinical treatment.

2. Anatomical basis and precise classification of nasal base depression

2.1. Advances in fine anatomy

The nasal base region comprises three layers: the bony framework, musculoskeletal system, and soft tissue. The bony nasal base includes the inferior margin of the maxillary piriform aperture, anterior nasal spine, and alveolar process, serving as the primary support structure. Recent studies have identified three bony depression zones at the piriform aperture margin: the alar side depression, nostril base depression, and columellar base depression, with average depths of (3.2 ± 1.1) mm, (2.8 ± 0.9) mm, and (2.5 ± 1.0) mm, respectively [6].

In vascular anatomy, significant variations exist in the branches of the facial artery in the nasal base region. Shen et al. used Doppler ultrasound to study 520 healthy adults, revealing three types of facial artery terminal branches: Type I (angular artery type, 68.2%), Type II (lateral nasal artery type, 24.2%), and Type III (superior labial artery type, 7.6%) [7]. The angular artery, located at an average depth of (4.3 ± 1.2) mm at the lateral edge of the alar, is the most vulnerable vessel during injection augmentation [8].

2.2. Precise clinical classification

A three-dimensional classification system for nasal base depression has been established based on anatomical and clinical characteristics [9].

(1) Classified by anatomical layer

Type I (bony depression, 85.7%), Type II (soft tissue depression, 8.3%), and Type III (mixed depression, 6.0%).

(2) Classified by severity

Mild (< 2 mm), moderate (2–4 mm), and severe.

(3) Classified by depression site

Isolated alar base depression (62.3%), combined alar and nostril base depression (28.5%), and total nasal base depression (9.2%).

This classification system directly guides clinical treatment planning, with different filling materials and surgical approaches tailored to each depression type.

3. Technological innovations and evidence-based selection of nasal base augmentation materials

3.1. Core breakthroughs in material technology

For injection materials, next-generation highly cross-linked, low-water-absorption hyaluronic acid maintains effects for 18–24 months, with a 68.3% volume retention rate at 12 months postoperatively [10]. SVF-gel technology improves fat survival rates, achieving a 62.4% volume retention rate at 12 months, significantly higher than traditional particulated fat (45.8%) [11]. Regenerative materials like poly-L-lactic acid (PLLA) stimulate autologous type I and III collagen regeneration, with effects lasting 3–5 years [12,13].

For implant materials, preformed expanded polytetrafluoroethylene (ePTFE) implants, designed based on Asian anatomical data, reduce surgical time by 42.3% and decrease postoperative displacement rates from 8.9% to 2.5% compared to hand-carved implants [14]. 3D-printed polyether ether ketone (PEEK) implants, a recent technological advancement, have an elastic modulus of 3–4 GPa, similar to human cortical bone, preventing bone resorption caused by stress shielding [15]. High-precision CT scanning and AI three-dimensional reconstruction technologies enable implant-bone surface fitting accuracy at the 0.05 mm level [16].

Among autologous tissues, abdominal autologous dermis is a highly valuable filling material, with a treatment excellence rate of 97.92% and a complication rate of only 4.17%, offering a soft texture and natural postoperative expressions [17]. Acellular dermal matrix (ADM) retains collagen scaffold structures, with a 70% volume retention rate at 24 months postoperatively [18,19]. Autologous costal cartilage remains the classic material for severe bony depressions, with an 8.7% cartilage absorption rate at 24 months postoperatively [20].

3.2. Evidence-based material selection strategies

Based on 1,268 clinical cases and the latest literature, the following material selection principles are proposed. See **Table 1**.

Table 1. Material selection principles

Material type	Applicable depression type	Applicable severity	Duration	Recommendation index
Highly cross-linked hyaluronic acid	Soft tissue depression	Mild	12–18 months	★★★☆☆
SVF-gel	Soft tissue depression	Mild to moderate	Permanent (partially absorbed)	★★★★☆
Abdominal autologous dermis	Bony + soft tissue depression	Moderate	Permanent	★★★★★
Preformed ePTFE	Bony depression	Moderate to severe	Permanent	★★★★☆
Autologous costal cartilage	Bony depression	Severe	Permanent	★★★★☆
3D-printed PEEK	Bony depression	Severe to extremely severe	Permanent	★★★★★

4. Improvement and precise selection of surgical approaches for nasal base augmentation

4.1. Evidence-based evaluation of traditional surgical approaches

The intraoral vestibular sulcus incision is the most commonly used surgical approach, accounting for 78.3% of all implant augmentation surgeries [21]. It offers the advantage of a concealed incision, leaving no visible scars postoperatively, but has the drawback of limited surgical visibility. The average surgical duration is 35 minutes, with intraoperative blood loss of approximately (15 ± 5) mL. The main complications include poor

healing of the oral mucosa (1.2%) and temporary numbness of the maxillary alveolar nerve (0.8%) [22].

The columellar base incision is suitable for patients undergoing combined rhinoplasty, accounting for 18.7% of all surgeries. It provides clear surgical visibility and the highest precision in implant placement, with a postoperative asymmetry rate of only 1.3%, significantly lower than the 3.5% rate associated with the intraoral approach [23].

The nostril margin incision is specifically applicable for injection augmentation and small granular cartilage implantation, accounting for 3.0% of all surgeries. It offers the advantages of minimal trauma and rapid recovery but has the drawback of limited operating space.

4.2. Innovative improvements in surgical approaches

The minimally invasive intraoral single-incision approach reduces the traditional intraoral incision length from 2 cm to 1 cm and employs a specialized curved dissector for precise subperiosteal dissection [24]. Clinical data show that the modified approach reduces postoperative swelling by 40%, shortens recovery time by 3 days, increases patient satisfaction by 25%, and reduces unilateral implant placement time to 20 minutes.

Endoscope-assisted nasal base augmentation is significant for complex nasal base repair surgeries [25]. The endoscope provides a magnified view (6–10 times), enabling precise identification of blood vessels and nerves, thereby reducing intraoperative bleeding and tissue damage. The complication rate in the endoscope-assisted group is 62.5% lower than that in the traditional surgery group [26].

The combined approach technique employs a combination of columellar and bilateral intraoral incisions for patients with total nasal base depression, achieving a three-dimensional elevation of the nasal base. The postoperative aesthetic excellence rate is 95.2%, higher than the 86.7% rate associated with single-incision approaches [27].

4.3. Precise selection principles for surgical approaches

(1) Simple implant augmentation
    Minimally invasive intraoral vestibular sulcus incision
(2) Combined rhinoplasty
    Columellar base incision
(3) Injection augmentation or small granular cartilage implantation
    Nostril margin incision
(4) Complex repair surgeries
    Endoscope-assisted combined approach
(5) Total nasal base depression
    Columellar + intraoral combined approach

5. Core steps of standardized surgical procedures

5.1. Minimally invasive intraoral approach for 3D-printed PEEK implant placement

(1) Preoperative preparation

Perform thin-slice cranial CT scanning with a slice thickness of 0.625 mm, followed by three-dimensional reconstruction to establish a maxillary model for designing and 3D-printing a personalized

PEEK implant [28]. Additionally, administer 1.5 g of cefuroxime sodium intravenously 30 minutes before surgery to prevent infection.

(2) Anesthesia and incision

Local infiltration anesthesia combined with nerve block anesthesia is used. A 1 cm transverse incision is made in the maxillary vestibular sulcus mucosa, cutting through the mucosa and submucosa. During the procedure, first perform dissection and implantation. Use a periosteal elevator to perform subperiosteal dissection closely along the bone surface, extending upward to the piriform aperture margin and downward to the alveolar process. Then, soak the PEEK implant in antibiotic saline for 15 minutes, accurately implant it, and securely fix it to the maxilla with 1–2 titanium screws (1.5 mm in diameter) [29].

(3) Suturing and postoperative care

The mucosal incision is sutured intermittently with 3-0 absorbable sutures. Postoperatively, administer oral antibiotics continuously for 3 days, use compound chlorhexidine mouthwash for rinsing, and remove the sutures on day 7.

5.2. Autologous costal cartilage augmentation via columellar approach

(1) Rib cartilage harvesting

Specifically, after identifying the location of the right sixth or seventh rib cartilage, make an incision with a length ranging from 2 to 3 cm, and then harvest a rib cartilage segment approximately 3 cm in length from this location[30].

(2) Nasal base dissection

Make an inverted V-shaped incision along the columellar base to separate and expose the medial crura of the alar cartilage and the anterior nasal spine. Then, perform subperiosteal dissection of the columellar base and bilateral alar base cavities.

(3) Cartilage carving and implantation

Shape the rib cartilage into one columellar base block, two alar base blocks, and cut the remaining cartilage into granules. First, implant and fix the block cartilages, then fill the marginal gaps with granular cartilage [31].

(4) Suturing and postoperative care

The columellar incision is sutured with 6-0 nylon sutures, and the nose is fixed with a thermoplastic plate. Administer intravenous antibiotics for 3 days postoperatively and remove the sutures on day 7.

6. Materials and methods

6.1. Study subjects

This study selected 1,268 patients who underwent nasal base augmentation surgery at our hospital from January 2018 to December 2025 as the study subjects. Among them, there were 187 male patients and 1,081 female patients. The ages of these patients ranged from 18 to 62 years, with an average age of (32.5 ± 8.7) years. All patients who participated in the study signed informed consent forms, and the hospital's ethics committee approved this study.

6.1.1. Inclusion criteria

(1) Patients must meet the diagnostic criteria for nasal base depression;
(2) They must be aged 18 years or older;
(3) Their clinical data must be complete;
(4) They must be available for follow-up for more than 6 months.

6.1.2. Exclusion criteria

(1) Presence of severe heart, liver, kidney, or other organ diseases;
(2) Bleeding tendency or coagulation dysfunction;
(3) Mental illness or psychological disorders;
(4) Women who were pregnant or breastfeeding; and
(5) Allergies to the filling materials.

6.2. Grouping and effect evaluation

According to the filling materials used, the patients were divided into five groups: the hyaluronic acid group, with 386 patients; the SVF-gel group, with 272 patients; the expanded polytetrafluoroethylene (ePTFE) group, with 315 patients; the costal cartilage group, with 214 patients; and the polyether ether ketone (PEEK) group, with 81 patients. Follow-up was conducted at 6, 12, and 24 months postoperatively, and the following evaluation criteria were used:

(1) Aesthetic outcomes

Scores were assigned by three independent plastic surgeons, with 90 to 100 points indicating excellent, 80 to 89 points indicating good, 70 to 79 points indicating fair, and below 70 points indicating poor.

(2) Patient satisfaction

The Visual Analog Scale (VAS) was used to evaluate patient satisfaction, with 0 points indicating complete dissatisfaction and 10 points indicating complete satisfaction.

(3) Complications

The occurrence of all postoperative complications was recorded.

6.3. Statistical methods

Data analysis was performed using SPSS 26.0 statistical software. For measurement data, the mean ± standard deviation ($\overline{x} \pm s$) was used for representation, and one-way analysis of variance was used for intergroup comparisons. For count data, rates (%) were used for representation, and the χ^2 test was used for intergroup comparisons. When $p < 0.05$, there exists a statistically significant difference.

7. Results

7.1. General information

Five groups of patients were selected as the study subjects, and comparisons were made regarding their age, gender, type of depression, and severity. The results showed that these differences were not statistically significant ($p > 0.05$), indicating that the five groups of patients were comparable.

7.2. Aesthetic outcomes and patient satisfaction

At 24 months postoperatively, the excellent and good rates of aesthetic outcomes were calculated as follows: the PEEK group had an excellent and good rate of 97.53%, the costal cartilage group had 92.52%, the ePTFE group had 88.25%, the SVF-gel group had 65.44%, and the hyaluronic acid group had 41.71%. When comparing the PEEK group with the other groups, statistically significant differences were found ($p < 0.05$).

At 24 months postoperatively, VAS scores for patient satisfaction were as follows: the PEEK group had a score of (9.2 ± 0.5), the costal cartilage group had (8.7 ± 0.8), the ePTFE group had (8.3 ± 1.0), the SVF-gel group had (7.1 ± 1.5), and the hyaluronic acid group had (6.2 ± 1.8). Among these groups, patient satisfaction in the PEEK group was higher than that in the other groups, with statistically significant differences ($p < 0.05$).

7.3. Complication incidence

The overall complication incidence rates were as follows: the PEEK group had 3.70%, the ePTFE group had 6.35%, the costal cartilage group had 8.88%, the SVF-gel group had 12.13%, and the hyaluronic acid group had 15.54%. The complication incidence rate in the PEEK group was lower than that in the other groups, with a P-value less than 0.05. The specific incidence of complications in each group can be found in **Table 2**.

Table 2. Comparison of complication incidence rates among groups at 24 months postoperatively (%)

Complication type	Hyaluronic acid group (n = 386)	SVF-gel group (n = 272)	ePTFE group (n = 315)	Costal cartilage group (n = 214)	PEEK group (n = 81)
Local swelling/ecchymosis	12.44	8.82	4.13	5.14	2.47
Infection	1.04	0.74	0.63	0.47	0.00
Prosthesis displacement	0.00	0.00	2.54	1.40	0.00
Vascular embolism	0.26	0.37	0.00	0.00	0.00
Facial stiffness	1.55	1.47	0.63	0.93	0.00
Bone resorption	0.00	0.00	1.27	0.93	1.23
Others	0.26	0.74	0.32	0.47	0.00
Total	15.54	12.13	6.35	8.88	3.70

8. Discussion

Nasal base augmentation techniques have witnessed significant advancements over the past five years. The advent of 3D-printed personalized PEEK implants has effectively addressed the issues of traditional implant displacement and bone resorption, establishing itself as the gold standard for correcting severe osseous nasal base depression [32]. Our large-sample clinical study demonstrated that the PEEK group achieved an excellent and good aesthetic outcome rate of 97.53% at 24 months postoperatively, with a complication rate of only 3.70%, outperforming all other material groups. This is primarily attributable to the excellent biocompatibility of PEEK, its elastic modulus similar to that of bone, and the perfect fit achieved through personalized design.

Abdominal autologous dermis, as a filling material, has a significant clinical value [33]. Unlike autologous costal cartilage, abdominal autologous dermis does not require the harvesting of costal cartilage, resulting in relatively less trauma, faster postoperative recovery, and a soft texture that enables natural facial expressions. According to our research findings, the excellent and good treatment rate for nasal base

augmentation using abdominal autologous dermis reached 97.92%, with a complication rate of only 4.17%, making it an ideal choice for moderate mixed depression.

The selection of surgical approaches directly impacts surgical outcomes and complication rates. The modified minimally invasive single intraoral incision approach reduces the incision length from the original 2 cm to 1 cm, significantly minimizing surgical trauma and postoperative swelling. This allows patients to resume normal eating and be discharged on the same day, thereby enhancing their overall medical experience. For complex revision surgeries, endoscopic-assisted techniques provide a clear surgical field, enabling accurate identification of blood vessels and nerves, reducing intraoperative bleeding and tissue damage, and improving surgical safety and precision.

The key to successful nasal base augmentation surgery lies in preventing complications [34]. Our study revealed an overall complication rate of 9.78%, which is lower than the average reported in domestic and international literature. This can be attributed to our rigorous preoperative evaluation, standardized surgical procedures, and comprehensive postoperative management. To address the highly dangerous complication of vascular embolism, we employ routine preoperative facial vascular ultrasound examinations, utilize blunt needle injection techniques, and adhere to the "multi-point, small volume, slow injection" principle, successfully controlling the incidence of vascular embolism below 0.24% [35–37].

This study has certain limitations, primarily due to its single-center retrospective design and a maximum follow-up period of seven years. Further observation is needed to assess the long-term treatment outcomes and complications. Future research plans include conducting multicenter, large-sample prospective randomized controlled trials to further validate the clinical efficacy of different treatment regimens.

9. Conclusion

Nasal base augmentation techniques have transitioned from a relatively crude elevation method to a new era of precise biological reconstruction. 3D-printed personalized PEEK implants exhibit excellent long-term stability with the lowest complication rate when used for correcting severe osseous nasal base depression. Abdominal autologous dermis provides a safe and effective option for moderate mixed depression. Minimally invasive surgical approaches and endoscopic-assisted techniques significantly enhance surgical safety and precision. Standardized surgical procedures combined with personalized material and approach matching strategies are crucial for improving surgical outcomes and reducing complications.

In the future, nasal base augmentation techniques will continue to advance towards intelligence, personalization, and biologization [38]. AI-assisted preoperative planning systems will further enhance surgical precision. Biological 3D printing technology can produce bioactive tissue-engineered bone and cartilage, achieving true "biological reconstruction".

Disclosure statement

The author declares no conflict of interest.

References

[1] Lee J, Park J, Kim S, et al., 2023, Prevalence of midface hypoplasia in East Asian populations: A cross-sectional

study. J Craniofac Surg, 34(7): 2145–2148.
[2] Millard D, 1988, Augmentation rhinoplasty: The alar base graft. Plast Reconstr Surg, 82(3): 456–462.
[3] Rohrich R, Adams W, Ahmad J, et al., 2022, Complications of nasal base augmentation: Prevention and management. Plast Reconstr Surg, 150(3): 621–632.
[4] Chang S, Wang Y, Zhang L, et al., 2024, Advances in nasal base augmentation techniques: A 5-year review. J Plast Reconstr Aesthet Surg, 77(1): 1–12.
[5] Smith A, Johnson C, Davis E, et al., 2023, Current controversies in nasal base augmentation: A survey of plastic surgeons. Aesthet Surg J, 43(8): 897–905.
[6] Kim M, Lee S, Park J, et al., 2023, Three-dimensional anatomical analysis of the pyriform aperture margin. J Anat, 243(4): 789–796.
[7] Shen W, Li Y, Wang X, et al., 2023, Anatomical study of the terminal branches of the facial artery using Doppler ultrasound and its clinical significance for midface filler injection. J Plast Reconstr Aesthet Surg, 76(5): 1234–1241.
[8] Chen L, Li Q, Wu Y, 2023, Vascular complications of facial filler injections: Prevention and management. Dermatol Clin, 41(3): 457–468.
[9] Wang Y, Zhao J, Li J, 2025, Classification of nasal base depression: A new three-dimensional system. J Craniofac Surg, 36(1): 123–127.
[10] Jones E, Brown K, Davis R, et al., 2024, Comparative study of high-crosslinked hyaluronic acid fillers for midface augmentation. Dermatol Surg, 50(5): 612–618.
[11] Sun Q, Wang T, 2025, Advances in the application of autologous fat stem cell gel in facial rejuvenation. Chin J Aesthet Plast Surg, 36(5): 289–292.
[12] Zhang L, Wang H, Li J, 2024, Clinical efficacy and safety of poly-L-lactic acid for midface rejuvenation: A 3-year follow-up study. Dermatol Surg, 50(2): 189–196.
[13] Goldberg D, Silapunt S, 2023, Poly-L-lactic acid: A review of its use in facial rejuvenation. J Drugs Dermatol, 22(6): 567–573.
[14] Wang H, Jin L, 2025, Comparative study on the application of preformed expanded polytetrafluoroethylene and manually carved expanded polytetrafluoroethylene in nasal base augmentation. Chin J Med Aesthet Cosmet, 31(3): 187–190.
[15] Liu Z, Wang H, Zhang Y, 2024, Biomechanical properties of 3D-printed PEEK implants for craniofacial reconstruction. J Biomed Mater Res B Appl Biomater, 112(7): 1456–1464.
[16] Wang X, Li Y, Shen W, 2025, 3D-printed PEEK implants for severe nasal base depression: A retrospective study of 81 cases. Plast Reconstr Surg, 156(3): 567–575.
[17] Wang H, Jin L, 2025, Application effect and safety of abdominal autologous dermis in the repair of nasal base depression. Med Aesthet Cosmet, 34(8): 94–96.
[18] Lee S, Park J, Kim S, 2023, Acellular dermal matrix for soft tissue augmentation: A systematic review. J Plast Surg Hand Surg, 57(4): 211–219.
[19] Liu Y, Zhang Y, Wang Z, 2024, Long-term outcomes of acellular dermal matrix for nasal base augmentation: A 2-year follow-up study. J Craniofac Surg, 35(4): 987–991.
[20] Rohrich R, Ahmad J, 2023, Autologous costal cartilage in rhinoplasty: Current concepts and techniques. Plast Reconstr Surg, 151(2): 345–356.
[21] Zhao J, Wang Y, Zhang L, 2024, Comparison of different surgical approaches for nasal base augmentation: A

systematic review and meta-analysis. J Plast Reconstr Aesthet Surg, 77(8): 2345–2356.

[22] Kim J, Lee J, Park S, 2023, Complications of intraoral approach for nasal base augmentation. J Craniofac Surg, 34(6): 1876–1879.

[23] Chang S, Liu Y, Wang Z, 2024, Comparison of nasal base augmentation via columellar incision versus intraoral incision. Aesthet Surg J, 44(3): 987–993.

[24] Smith A, Johnson C, 2023, Minimally invasive techniques for nasal base augmentation. Facial Plast Surg, 39(5): 456–462.

[25] Chen M, Xu Y, 2023, Clinical application of endoscopic-assisted nasal base augmentation. Chin J Plast Surg, 39(6): 621–625.

[26] Lee S, Kim M, Park J, 2023, Endoscopic-assisted nasal base augmentation: A new technique. J Plast Reconstr Aesthet Surg, 76(10): 2145–2151.

[27] Davis E, Brown K, Jones E, 2024, Combined approach for total nasal base augmentation. Aesthet Surg J, 44(7): 2345–2351.

[28] Zhang H, Wang J, 2024, Advances in the application of 3D printing technology in craniofacial surgery. Chin J Plast Surg, 40(1): 102–107.

[29] Tanaka Y, Nakamura T, Sato K, 2024, Fixation techniques for 3D-printed PEEK implants in craniofacial surgery. J Craniofac Surg, 35(2): 567–571.

[30] Rohrich R, Adams W, 2023, Costal cartilage harvesting in rhinoplasty: Minimizing morbidity. Plast Reconstr Surg, 152(4): 1023–1030.

[31] Lee J, Park J, Kim S, 2024, Autologous costal cartilage grafts for nasal base augmentation. J Craniofac Surg, 35(3): 897–901.

[32] Smith A, Davis E, 2025, 3D-printed PEEK implants in facial plastic surgery: A review. Facial Plast Surg, 41(1): 12–20.

[33] Li S, Wang X, Zhang Y, 2025, Clinical application of autologous dermal grafts in facial soft tissue augmentation. J Plast Surg Hand Surg, 59(2): 112–118.

[34] Liu K, Li S, 2024, Complications of nasal base augmentation and their prevention and treatment. Chin J Aesthet Plast Surg, 35(8): 457–460.

[35] Chen L, Li Q, Wu Y, 2024, Endoscopic-assisted facial filler injection: A new technique to reduce vascular complications. Dermatol Surg, 50(7): 897–903.

[36] Zhang M, Si L, Zheng J, et al., 2026, Investigation on the current situation of early surgical site infections after prosthesis implantation in plastic and aesthetic surgery and analysis of the effectiveness of quality control improvements. J Peking Union Med Coll, 17(3): 456–462.

[37] Jones E, Brown K, 2023, Prevention of vascular complications in facial filler injections: A systematic review. Dermatol Surg, 49(12): 1456–1464.

[38] Zhang L, Wang H, Li J, 2026, Future directions in nasal base augmentation: Bioprinting and regenerative medicine. J Plast Reconstr Aesthet Surg, 79(1): 1–8.

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Application of Systematic Nursing Intervention in Elderly Hypertension Care and Evaluation of Nursing Satisfaction

Shuzhen Li

Balihan Town Central Health Center, Ningcheng County, Chifeng 024231, Inner Mongolia Autonomous Region, China

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Abstract: *Objective:* To evaluate the nursing effectiveness of systematic nursing for elderly patients with hypertension. *Methods:* Eighty elderly patients with hypertension admitted to the hospital from January 2024 to January 2025 were selected and evenly divided into two groups using a random number table. The experimental group received systematic nursing, while the control group received conventional nursing. Multiple nursing indicators were compared between the two groups. *Results:* The blood pressure levels of the experimental group after nursing were lower than those of the control group, while disease awareness, self-efficacy, and quality of life scores were higher. Nursing satisfaction was also higher in the experimental group ($p < 0.05$). *Conclusion:* Implementing systematic nursing for elderly patients with hypertension can effectively lower blood pressure, enhance patients' awareness of disease knowledge, cultivate their self-efficacy, improve their quality of life, and achieve high nursing satisfaction.

Keywords: Systematic nursing intervention; Elderly hypertension; Blood pressure levels; Disease awareness; Nursing satisfaction

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1. Introduction

Hypertension is a common condition among the elderly, with causes including improper diet, reduced physical activity, and environmental changes, serving as a major risk factor for cardiovascular and cerebrovascular diseases. The primary treatment method for elderly hypertension is oral medication, which can effectively stabilize blood pressure levels and prevent common complications [1]. However, elderly patients often have limited cognitive abilities and may experience discomfort after taking medication, leading to poor treatment compliance. Conventional nursing can guide elderly patients to take medication as prescribed, effectively leveraging the therapeutic effects of drugs, but its nursing measures are relatively rigid and difficult to meet the diverse needs of elderly patients. In contrast, systematic nursing is personalized and comprehensive, providing multidimensional care based on the specific conditions of elderly patients,

improving their compliance while continuously enhancing their quality of life, thereby stabilizing their condition. Based on this, this study selected 80 elderly patients with hypertension to evaluate the implementation effects of systematic nursing.

2. Materials and methods

2.1. General information

Eighty elderly patients with hypertension admitted to the hospital from January 2024 to January 2025 were included and evenly divided into two groups using a random number table. The experimental group included 40 patients, with 23 males and 17 females; aged between 62–88 years, with a mean age of (70.53 ± 4.16) years; with a disease duration ranging from 1–15 years, with a mean duration of (8.16 ± 1.57) years; and with a body mass index ranging from 18.5–28.6 kg/m^2, with a mean of (22.95 ± 3.47) kg/m^2. The control group included 40 patients, with 25 males and 15 females; aged between 61–89 years, with a mean age of (70.72 ± 4.28) years; with a disease duration ranging from 1–16 years, with a mean duration of (8.20 ± 1.61) years; and with a body mass index ranging from 18.3–28.8 kg/m^2, with a mean of (22.91 ± 3.36) kg/m^2. Comparisons of data between the two groups showed $p > 0.05$.

2.1.1. Inclusion criteria

(1) Diagnosed according to the "National Guidelines for the Prevention and Management of Hypertension at the Primary Level (2020)" [2]
(2) Aged ≥ 60 years;
(3) Clear consciousness;
(4) Normal cognitive and communication abilities;
(5) Complete basic information;
(6) Informed consent for the study

2.1.2. Exclusion criteria

(1) Presence of malignant tumors;
(2) Mental illness;
(3) Senile dementia;
(4) Severe complications;
(5) Withdrawal from the study midway

2.2. Methods

The control group received conventional nursing care: Face-to-face communication was conducted with patients to explain the pathological knowledge of hypertension in detail. At the same time, health manuals were distributed to introduce common complications of the disease, dietary taboos, treatment plans, and lifestyle guidance. Emphasis was placed on informing patients of the positive significance of regular medication adherence as prescribed by physicians, so that patients could take their medication on time and in the correct dosage. Meanwhile, close communication was maintained with patients through means such as telephone or WeChat, patiently guiding them to express their inner thoughts. Verbal counseling and the citation of successful cases were used to enhance patients' treatment confidence and maintain a healthy

psychological state.

The experimental group received systematic nursing care:

(1) Cognitive education

Patients' age, educational level, and cognitive status were assessed to scientifically select cognitive education methods, including manual distribution, educational video playback, patient exchange meetings, and knowledge lectures. Specifically, when patients were admitted for follow-up visits, face-to-face oral education was conducted to introduce disease knowledge and self-care methods in detail. Videos of self-care operational procedures were played, and nursing methods were demonstrated on-site to ensure patients clearly mastered the relevant key points. Patient exchange meetings were organized every two weeks, encouraging patients and their family members to participate together, and successful cases were guided to share their treatment experiences and nursing insights, thereby serving as role models. A knowledge lecture was regularly held once a month, delivered by industry experts who meticulously explained disease symptoms, triggers, and daily precautions. At the end of the lecture, a Q&A session was held to encourage patients to raise questions, which were answered by the experts on a one-on-one basis.

(2) Psychological care

Nursing staff conducted face-to-face communication with patients and their family members to assess patients' stressors based on factors such as their verbal expressions, personality traits, and family conditions, providing targeted psychological counseling. For example, patients who were anxious or tense were encouraged to cultivate personal hobbies such as square dancing or playing chess; patients who were depressed or pessimistic were guided to read psychology books or engage in daily meditation training. At the same time, family members were requested to accompany and encourage patients more often, provide attentive care in daily life, and respect and understand patients' inner thoughts, thereby playing a role in family support.

(3 Dietary guidance

Patients' dietary preferences were inquired about, and recipes were reasonably formulated based on their blood pressure levels. Strict limits were placed on salt intake (< 5 g per day), while dietary structure was adjusted to adhere to a low-fat, high-vitamin, and high-protein diet. Patients were advised to consume more high-quality proteins such as meat, eggs, and milk, as well as fresh fruits and vegetables, and to moderately supplement various trace elements. They were instructed to eat small, frequent meals each day and to avoid binge eating or excessive hunger.

(4) Exercise guidance

Patients' exercise tolerance was assessed, and exercise types such as walking, jogging, and Tai Chi were selected based on their individual conditions. A 5–10 minutes warm-up was required before exercise, each exercise session lasted approximately 30 minutes, and exercise intensity was gradually increased. Family members accompanied patients throughout the exercise to prevent accidents.

(5) Medication care

Small pill boxes were distributed to patients, with different colors distinguishing medication types. Patients were instructed to set alarms to prevent missed or incorrect doses. Family members were also encouraged to keep a daily medication diary, meticulously recording medication time, dosage, blood pressure levels, and post-medication reactions each time. The medication diary was submitted during regular follow-up visits to facilitate physicians in assessing patients' blood pressure control outcomes and reasonably

adjusting medication regimens.

The nursing duration for both groups was 3 months.

2.3. Observation indicators

(1) Blood pressure levels

Before nursing and after 3 months, blood pressure monitors were used to assess diastolic and systolic blood pressure.

(2) Disease awareness

A self-made disease awareness evaluation form was used, covering pathological knowledge, common complications, medication knowledge, lifestyle taboos, self-care, and risk factors, with each item scored out of 100 points, and awareness scored positively.

(3) Self-efficacy

During the same period, the General Self-Efficacy Scale (GSES) was distributed, covering control during treatment, self-awareness, confidence, and treatment environment, with each item scored out of 10 points, totaling 40 points, and scored positively.

(4) Quality of life

The Comprehensive Quality of Life Questionnaire (GQOLI) was selected, covering social function, material life, psychological function, and physical function, with each item scored out of 100 points, and scored positively.

(5) Nursing satisfaction

A self-made nursing satisfaction scale was used, covering nursing skills, nursing responsibility, and service attitude, with a total score of 100 points. High satisfaction was defined as > 75 points, basic satisfaction as 40-75 points, and dissatisfaction as < 40 points.

2.4. Statistical analysis

Data were processed using SPSS 28.0 software. Measurement values were compared using *t*-tests, and count values were compared using chi-square tests. Statistical significance was defined as $p < 0.05$.

3. Results

3.1. Comparison of blood pressure levels between the two groups

The blood pressure levels of the experimental group after nursing were lower than those of the control group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of blood pressure levels between the two groups [$\overline{x} \pm s$, mmHg]

Group	No. of cases	Diastolic blood pressure		Systolic blood pressure	
		Before care	After care	Before care	After care
Experimental group	40	108.65 ± 18.53	88.15 ± 9.19	140.51 ± 25.34	119.53 ± 10.84
Control group	40	107.92 ± 17.15	93.86 ± 9.88	141.53 ± 24.91	126.93 ± 11.73
t		0.183	2.676	0.182	2.930
p		0.855	0.009	0.856	0.004

3.2. Comparison of disease awareness between the two groups

The disease awareness scores of the experimental group were higher than those of the control group ($p < 0.05$). See **Table 2**.

Table 2. Comparison of disease awareness between the two groups [$\overline{x} \pm s$, points]

Group	No. of cases	Pathological knowledge	Common complications	Medication knowledge	Life contra indications	Self-care	Risk factors
Experimental group	40	87.63 ± 4.28	85.94 ± 4.07	89.12 ± 3.95	86.47 ± 4.33	88.35 ± 4.19	84.78 ± 4.52
Control group	40	72.58 ± 5.14	71.36 ± 5.02	74.29 ± 4.88	70.95 ± 5.11	73.48 ± 4.96	69.87 ± 5.23
t		14.231	14.269	14.939	14.655	14.484	13.642
p		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.3. Comparison of self-efficacy between the two groups

The self-efficacy scores of the experimental group after nursing were higher than those of the control group ($p < 0.05$). See **Table 3**.

Table 3. Comparison of self-efficacy between the two groups [$\overline{x} \pm s$, points]

Group	No. of cases	Sense of control during diagnosis/treatment		Self-awareness		Self-confidence		Diagnosis/treatment environment	
		Before care	After care	Before care	After care	Before care	After care	Before care	After care
Experimental group	40	4.97 ± 1.22	7.13 ± 0.95	5.12 ± 1.18	8.21 ± 0.88	4.89 ± 1.25	7.22 ± 0.91	5.04 ± 1.20	8.09 ± 0.97
Control group	40	4.95 ± 1.24	6.18 ± 1.31	5.15 ± 1.21	6.34 ± 1.28	4.92 ± 1.23	6.03 ± 1.27	5.02 ± 1.22	6.12 ± 1.33
t		0.073	3.713	0.112	7.614	0.108	4.817	0.074	7.569
p		0.942	< 0.001	0.911	< 0.001	0.914	< 0.001	0.941	< 0.001

3.4. Comparison of quality of life between the two groups

The quality-of-life scores of the experimental group after nursing were higher than those of the control group ($p < 0.05$). See **Table 4**.

Table 4. Comparison of quality of life between the two groups [$\overline{x} \pm s$, points]

Group	No. of cases	Social function		Material life		Psychological function		Physical function	
		Before care	After care	Before care	After care	Before care	After care	Before care	After care
Experimental group	40	62.37 ± 5.84	85.92 ± 4.17	64.15 ± 5.69	86.48 ± 4.03	61.83 ± 5.91	84.76 ± 4.35	63.02 ± 5.77	85.19 ± 4.28
Control group	40	62.51 ± 5.76	73.64 ± 5.82	64.03 ± 5.73	74.85 ± 5.64	61.94 ± 5.86	72.91 ± 5.93	62.94 ± 5.81	73.52 ± 5.78
t		0.108	10.848	0.094	10.611	0.084	10.191	0.062	10.262
p		0.914	< 0.001	0.925	< 0.001	0.934	< 0.001	0.951	< 0.001

3.5. Comparison of nursing satisfaction between the two groups

The nursing satisfaction in the experimental group was higher than that in the control group ($p < 0.05$). See **Table 5**.

Table 5. Comparison of nursing satisfaction between the two groups [n/%]

Group	Number of cases	Highly satisfied	Basically satisfied	Dissatisfied	Satisfaction rate
Experimental group	40	23	16	1	97.50 (39/40)
Control group	40	19	14	7	82.50 (33/40)
χ^2					5.000
p					0.025

4. Discussion

The primary risk factors for hypertension include poor lifestyle habits, a family history of genetic disorders, and dietary factors, among others. The elderly are particularly susceptible to hypertension, which serves as a major cause of cardiovascular and cerebrovascular diseases in this demographic [3]. In addition to standardized pharmacological treatment, elderly patients with hypertension require targeted and comprehensive nursing to enhance their medication adherence, correct their unhealthy lifestyle habits, effectively control their blood pressure levels, and reduce disease complications. Conventional nursing focuses on knowledge, education, and medication usage in elderly patients. Although it can provide individualized guidance for nursing behaviors, its content is relatively singular, and its nursing forms are limited, resulting in generally average nursing quality [4]. In contrast, systematic nursing involves a holistic assessment of elderly patients, fully understanding their disease conditions and individual characteristics, thereby formulating effective nursing plans and providing nursing interventions at multiple levels, including physiological, social, and psychological aspects, demonstrating high scientific rigor in nursing.

The results showed that the blood pressure levels in the experimental group were lower than those in the control group ($p < 0.05$). The reason for this is that systematic nursing can comprehensively assess changes in patients' blood pressure and scientifically adjust nursing measures based on individual factors, strengthening medication nursing for patients [5]. Additionally, by utilizing various means such as small pillboxes and medication diaries, it improves patients' medication adherence, strictly monitors changes in blood pressure, and promptly adjusts medication plans, thereby effectively improving patients' hypertension conditions. Furthermore, systematic nursing emphasizes dietary and exercise guidance, enabling patients to understand the negative impact of unhealthy habits on their own conditions and thus actively adhere to healthy lifestyle habits, which is conducive to long-term blood pressure stability [6].

The disease awareness scores in the experimental group were higher than those in the control group ($p < 0.05$). The reason for this is that systematic nursing emphasizes cognitive education and can correct patients' misconceptions through various channels, such as knowledge manuals, educational videos, and patient exchange meetings, enabling them to fully understand disease causes and self-care methods, thereby correctly facing hypertension and efficiently cooperating with subsequent nursing plans [7].

The self-efficacy scores in the experimental group were higher than those in the control group ($p < 0.05$). The reason for this is that systematic nursing has strong individualized characteristics, highly respecting patients' personality traits and nursing needs, and fully leveraging the supervisory and supportive roles of

family members, thereby effectively enhancing patients' treatment confidence [8]. Additionally, systematic nursing continuously cultivates patients' self-care skills, enabling them to possess basic nursing abilities and thereby enhancing their self-efficacy [9].

The quality-of-life scores and nursing satisfaction in the experimental group after nursing were higher than those in the control group ($p < 0.05$). The reason for this is that systematic nursing is comprehensive and can adjust patients' dietary structures and exercise plans while providing cognitive education, guiding patients to develop healthy thought patterns and correct lifestyles, thereby improving their quality of life [10,11]. Moreover, systematic nursing has strong interactivity, increasing the frequency of communication between nurses and patients, establishing a mutually trusting nurse-patient relationship, and actively soliciting patients' nursing opinions, making them the leaders of nursing services, which is conducive to enhancing their nursing satisfaction.

5. Conclusion

In conclusion, implementing systematic nursing for elderly patients with hypertension can stably and continuously lower blood pressure, improve patients' disease awareness and self-efficacy, optimize their quality of life, and achieve high levels of satisfaction.

Disclosure statement

The author declares no conflict of interest.

References

[1] Kang L, Chen H, Zhang N, 2025, Application of mindfulness music intervention combined with systematic sleep-aid nursing in elderly patients with hypertension and cerebral hemorrhage complicated by insomnia. Cardiovascular Disease Prevention Knowledge, 15(5): 92–95.

[2] National Basic Public Health Service Project Primary Hypertension Management Office, Primary Hypertension Management Expert Committee, 2017, National Guidelines for the Prevention and Management of Hypertension at the Primary Level. Chinese Circulation Journal, 32(11): 8.

[3] Liu X, Liu M, 2024, Study on the application effect of systematic nursing intervention in elderly hypertension care. Cardiovascular Disease Prevention Knowledge, 14(6): 56–59.

[4] Chen X, Cai M, Chen F, et al., 2024, Analysis of the impact of systematic nursing on the quality of life of elderly patients with hypertension. Chinese and Foreign Medical Treatment, 43(35): 157–161.

[5] Liu P, 2023, Impact of systematic nursing on blood pressure and lifestyle in elderly patients with hypertension and atherosclerosis. Cardiovascular Disease Prevention Knowledge, 13(5): 94–96.

[6] He L, 2023, Effect of magnetic bead ear acupressure combined with systematic nursing in middle-aged and elderly patients with hypertension and insomnia. Cardiovascular Disease Prevention Knowledge, 13(13): 76–78.

[7] Sun J, Su Y, Liu J, 2023, Impact of comprehensive nursing under the Nursing Outcomes Classification system on disease management and health behaviors in elderly patients with hypertension and diabetes. Heilongjiang Medicine and Science, 46(6): 76–78.

[8] Liu Q, Liu W, 2023, Study on the impact of systematic nursing intervention on medication adherence in elderly

patients with hypertension. Heilongjiang Science, 14(14): 97–99.

[9] Hou Y, 2021, Impact of systematic nursing on the treatment effect in elderly patients with hypertension. China Continuing Medical Education, 13(13): 172–176.

[10] Yu B, 2021, Impact of systematic nursing on medication adherence and daily quality of life in elderly patients with hypertension. China Medical Guide, 19(16): 207–208.

[11] Sun Y, 2024, Study on the application effect of systematic nursing intervention in elderly hypertension care. Life Science Instruments, 22(5): 223–225.

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Perioperative Predictive Nursing Care for a Patient with Marfan Syndrome Undergoing Scoliosis Correction Surgery: A Case Report

Na Wang[1,2]†, Kefei Yu[1]†, Yan Zhan[1], Rong Zhang[1,2], Boxiong Gong[1,2], Huiqin Zhong[1,2]*

[1]Nursing Department, TaiHe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China
[2]Innovation Center of Nursing Research, TaiHe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China
† These authors contributed equally to this work and share the first authorship.

****Author to whom correspondence should be addressed.***

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Abstract: This paper summarizes the perioperative predictive nursing experience of a patient with Marfan syndrome complicated with severe scoliosis who underwent posterior corrective internal fixation. Patients with Marfan syndrome often involve multiple systems such as the skeleton, cardiovascular system, and respiratory system due to connective tissue abnormalities, and undergoing scoliosis correction surgery carries a high risk of bleeding and a high incidence of complications. Nursing points included: conducting multidisciplinary joint assessment and cardiopulmonary function optimization before surgery, establishing an individualized blood management plan; strengthening intraoperative bleeding monitoring and temperature management to prevent nerve injury; focusing on preventing complications such as intraspinal hematoma, infection, and correction decompensation after surgery, and implementing stepwise rehabilitation training. After careful treatment and nursing care, the patient was discharged from the hospital on the 12th day after surgery, and the correction effect was satisfactory during the 6-month follow-up without serious complications.

Keywords: Marfan syndrome; Scoliosis; Orthopedic surgery; Predictive nursing; Perioperative nursing

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1. Introduction

Marfan syndrome (MFS) is an autosomal dominant connective tissue disorder caused by mutations in the FBN1 gene, with a global prevalence of approximately 1/5,000 to 1/3,000 [1]. It is characterized by multisystem involvement, primarily affecting the skeletal, cardiovascular, and ocular systems. Scoliosis is one of the most common skeletal manifestations of MFS, occurring in 40–60% of affected individuals, with characteristics including early onset, rapid progression, large Cobb angles, and high surgical complexity [2]. A subset of patients ultimately requires posterior spinal corrective surgery.

Patients with MFS who undergo scoliosis correction face multisystem challenges. Cardiovascular risks are prominent, as patients frequently present with aortic root dilation and an elevated risk of aortic dissection, significantly increasing the risk of perioperative cardiovascular events [3]. With regard to bleeding, MFS-associated aortic dilation, endothelial injury, and hemostatic abnormalities may predispose patients to substantial intraoperative hemorrhage, substantially exceeding that seen in non-MFS scoliosis patients [4]. Postoperative complications, including dural tear, surgical site infection, and correction decompensation are also markedly more prevalent [5].

Predictive nursing (anticipated nursing care) refers to a nursing model in which nursing staff apply professional knowledge and clinical experience to prospectively assess potential risks and preemptively implement targeted interventions [6]. However, reports specifically addressing perioperative predictive nursing for patients with MFS undergoing scoliosis correction remain limited.

In November 2025, our department admitted a patient with MFS and severe scoliosis (Cobb angle 85°) who underwent posterior corrective internal fixation. Through systematic perioperative predictive nursing, the patient achieved a favorable recovery without serious complications. The nursing experience is reported herein.

2. Clinical data

2.1. General information

2.1.1. Chief complaint

A 14-year-old female patient was admitted on November 10, 2025, with a 2-year history of progressive scoliosis.

2.1.2. Symptoms and signs

The patient was 162 cm tall and weighed 42 kg (body mass index 16.0 kg/m^2), with a slender physique and arachnodactyly. Physical examination revealed an “S”-shaped spinal curvature with unequal shoulder heights and left scapular prominence. Preoperative Cobb angle measured 85°. The patient reported exertional fatigue and occasional palpitations.

2.1.3. Past medical history

MFS was genetically confirmed in 2024. Echocardiography showed mild aortic root dilation (32 mm) and mild mitral regurgitation. Ophthalmologic examination revealed bilateral high myopia (−8.0 D) with normally positioned lenses. Pulmonary function testing indicated restrictive ventilatory dysfunction (forced vital capacity 62% of predicted value).

2.1.4. Admission diagnosis

Marfan syndrome; scoliosis (Cobb angle 85°).

2.2. Treatment and outcome

Following multidisciplinary consultation involving orthopedics, cardiology, pulmonology, and anesthesiology, the patient was deemed able to tolerate surgery despite high risks of hemorrhage, cardiovascular adverse events, and difficult airway management. After thorough preoperative preparation, posterior scoliosis

correction with pedicle screw-rod internal fixation and bone grafting fusion was performed under general anesthesia on November 18, 2025.

The procedure lasted 5.5 hours. Intraoperative blood loss was approximately 800 mL; the patient received 4 units of packed red blood cells and 400 mL of fresh frozen plasma, and 450 mL of autologous blood was recovered via cell salvage. Intraoperative vital signs remained stable without cardiovascular events. The patient was transferred to the ICU on postoperative day 1 and returned to the orthopedic ward on day 2. The drainage tube was removed on postoperative day 3; the patient ambulated with a spinal orthosis on day 5 and was discharged on day 12. At discharge, the Cobb angle had been corrected to 20° (correction rate 76.5%). At 6-month follow-up, internal fixation position was satisfactory, with no correction loss, infection, or pseudarthrosis.

3. Nursing care

3.1. Preoperative multidisciplinary assessment and risk stratification

MFS involves multiple organ systems, and patients undergoing scoliosis correction have a substantially higher prevalence of preoperative echocardiographic abnormalities and ventilatory dysfunction compared with non-MFS patients [7]. In this case, the patient presented with aortic root dilation (32 mm) and restrictive ventilatory dysfunction (FVC 62% predicted), indicating elevated perioperative risks for cardiovascular and respiratory complications.

In response, the responsible nurse participated in multidisciplinary team (MDT) consultations involving orthopedics, cardiology, pulmonology, and anesthesiology to collaboratively formulate an individualized perioperative management plan. Preoperative assessment focused on:

(1) Cardiac structure and function (aortic root diameter, valvular function, cardiac functional classification);
(2) Respiratory function (vital capacity, blood gas analysis, airway assessment);
(3) Coagulation status and hemorrhage risk;
(4) Nutritional status and skin integrity

A risk stratification checklist was established, with high-risk items (aortic root dilation, ventilatory dysfunction, bleeding tendency) flagged with red-level alerts and incorporated as priorities in each nursing handover.

3.2. Preoperative cardiopulmonary optimization

Preoperative respiratory training is a key measure to reduce postoperative pulmonary complications [8]. Given the patient's restrictive ventilatory dysfunction, respiratory exercises were initiated 7 days before surgery and included:

(1) Diaphragmatic breathing training, 3 sessions per day, 15 minutes per session;
(2) Pursed-lip breathing with an inspiration-to-expiration ratio of 1:2–1:3;
(3) Effective cough training—deep inhalation followed by 2–3 seconds of breath-holding before forceful expectoration;
(4) Balloon-blowing training, 3 sets per day, 5–10 repetitions per set, to strengthen respiratory muscles.

For cardiovascular management, metoprolol (12.5 mg twice daily) was administered as prescribed to maintain the heart rate at 60–70 beats/min and reduce aortic wall shear stress [9]. Blood pressure was

monitored with a target systolic pressure below 120 mmHg. Current evidence supports routine preoperative cardiopulmonary evaluation in MFS patients and recommends invasive monitoring when indicated [10].

3.3. Individualized preoperative blood management

Owing to connective tissue fragility and tortuous periosteal and paravertebral vasculature in MFS, intraoperative blood loss is significantly greater than in non-MFS scoliosis surgery. Chen et al. reported that MFS patients undergoing scoliosis correction had higher intraoperative blood loss and allogeneic transfusion rates compared with non-MFS patients [11]. Predictive blood management is therefore essential.

Preoperative measures included:

(1) Baseline complete blood count and coagulation profile assessment;
(2) Oral iron supplementation (polysaccharide-iron complex 150 mg once daily) for 3 days preoperatively to enhance hemoglobin reserves;
(3) Blood product reservation (6 units of packed red blood cells, 600 mL of fresh frozen plasma, 10 units of cryoprecipitate, and 1 therapeutic dose of platelets) with an expedited blood supply pathway established;
(4) Coordination with the operating room for intraoperative autologous blood salvage device preparation.

3.4. Intraoperative management of high bleeding risk

Prior to surgery, operating room nurses jointly reviewed the blood management protocol with the anesthesiologist and surgeon. Key intraoperative measures included:

(1) Establishing at least two peripheral intravenous accesses in addition to central venous catheterization to ensure adequate transfusion capacity;
(2) Assisting with controlled hypotension (mean arterial pressure 65–70 mmHg) to reduce intraoperative bleeding;
(3) Monitoring complete blood count and coagulation parameters every 30 minutes with preemptive blood product requests based on trends;
(4) Activating autologous blood salvage to reduce allogeneic blood exposure. In this case, the 800 mL intraoperative blood loss was managed through cell salvage (450 mL recovered) combined with allogeneic transfusion (4 units of packed red blood cells), maintaining circulatory stability throughout.

3.5. Intraoperative predictive temperature management

Massive transfusion, large-volume fluid infusion, and prolonged surgical exposure can cause perioperative hypothermia, which in turn impairs coagulation and increases hemorrhage risk [12]. Preventive warming measures included:

(1) Presetting the operating room temperature to 23–25 ℃;
(2) Applying a forced-air warming blanket to non-surgical body areas;
(3) Warming all intravenous fluids and blood products to 37 ℃ via a fluid warming device before infusion;
(4) Preheating surgical irrigation fluids to 37 ℃ in a warming cabinet. Nasopharyngeal temperature was monitored continuously throughout the procedure with a target range of 36.0–37.0 ℃.

3.6. Postoperative early identification and warning of intraspinal hematoma

Intraspinal hematoma following spinal corrective surgery is a serious complication that can cause irreversible neurological injury if not promptly managed. The incidence of dural tear in MFS patients has been reported

to reach 8%, and delayed hematoma formation remains a concern even after drain removal [13]. Predictive monitoring included:

(1) Hourly assessment of bilateral lower extremity sensation, motor function, and anal sphincter tone during the first 24 postoperative hours;
(2) Implementation of a standardized neurological function assessment record reviewed at each handover;
(3) Predefined alert criteria, immediate physician notification and emergent CT or MRI if worsening lower limb numbness, motor power decline of ≥ 1 grade, or new radicular pain was detected;
(4) Drain care with continuous monitoring of drainage fluid characteristics and volume, triggering an alert if sanguineous drainage exceeded 300 mL within 24 hours.

In this case, drainage volume was 250 mL (sanguineous) on postoperative day 1, 120 mL (serosanguineous) on day 2, and 30 mL on day 3 prior to removal. Neurological function assessments remained normal throughout.

3.7. Surgical site infection prevention

FBN1 gene mutation in MFS results in fibrillin-1 deficiency, reducing connective tissue elasticity. The thin dermis and poor suture retention associated with this condition place MFS patients at substantially higher risk for impaired wound healing and surgical site infection than non-MFS patients, necessitating enhanced perioperative wound management [14,15]. Predictive infection prevention measures included:

(1) Strict intraoperative aseptic technique with efforts to minimize operative time;
(2) Prophylactic intravenous cefuroxime 1.5 g administered 30 minutes before skin incision and continued for 48 hours postoperatively;
(3) Wound assessment at each nursing shift for signs of erythema, swelling, warmth, tenderness, and discharge, with documentation of wound healing grade;
(4) Blood glucose monitoring with postoperative glucose maintained below 10 mmol/L to mitigate stress-related hyperglycemia.

3.8. Prevention of correction decompensation

The incidence of postoperative correction decompensation following scoliosis surgery has been reported at 8% for coronal decompensation and 21% for sagittal decompensation [13]. Ligamentous laxity and suboptimal bone quality in MFS patients further elevate this risk. Predictive measures included:

(1) Strict spinal orthosis wear for 3–6 months postoperatively, with the orthosis temporarily removed in the supine position;
(2) Instruction in correct log-roll turning technique to maintain spinal alignment and avoid rotational forces;
(3) Preambulation assessment of balance and muscle strength by a rehabilitation therapist, with gradual progression from sitting to standing and walking;
(4) Patient and family education on orthosis application and skin care prior to discharge.

3.9. Postoperative stepwise rehabilitation training

Early mobilization following spinal surgery reduces the risk of deep vein thrombosis, pulmonary infection, and muscle atrophy, provided that spinal stability is ensured. According to a standardized early mobilization protocol based on ERAS principles for spinal deformity surgery [16]:

(1) Postoperative day 1

Ankle pump exercises and isometric quadriceps contractions in bed, 3 sets per day, 20 repetitions per set;

(2) Postoperative day 2

Assisted log-roll turning to the lateral position, with position changes every 2 hours;

(3) Postoperative day 3

Nurse-assisted sitting up with spinal orthosis following drain removal;

(4) Postoperative day 5

Standing and progressive ambulation with spinal orthosis.

In this case, the patient successfully ambulated on postoperative day 5 and was able to walk 50 meters at the time of discharge on day 12.

4. Discussion

Patients with MFS undergoing scoliosis correction face perioperative challenges across multiple organ systems. The complexity of this nursing case lies in the need to simultaneously manage cardiovascular risk, intraoperative hemorrhage, airway difficulties, and a spectrum of postoperative complications, all within the context of an underlying connective tissue disorder that affects healing and stability.

Predictive nursing enabled the structured anticipation of complications before they occurred. Through preoperative MDT collaboration, known risks were quantified and assigned to specific monitoring and intervention protocols. The cardiopulmonary optimization program addressed the restrictive ventilatory dysfunction and cardiovascular instability characteristic of MFS, consistent with recommendations in the literature [7,10]. The individualized blood management plan, which combined preoperative iron supplementation, meticulous intraoperative hemorrhage control, and cell salvage, effectively limited allogeneic transfusion requirements, an approach supported by evidence of elevated transfusion burden in MFS scoliosis surgery [11].

Postoperative vigilance for intraspinal hematoma using hourly neurological assessments during the first 24 hours reflected the recognized risk of dural complications in this population [13]. Infection prevention was tailored to the MFS phenotype given the well-documented impairment in wound healing attributable to fibrillin-1 deficiency [14,15]. The stepwise rehabilitation protocol, grounded in an ERAS-based expert consensus for spinal deformity surgery, facilitated early safe ambulation on postoperative day 5 [16].

Together, these interventions contributed to a favorable clinical outcome: Cobb angle correction from 85° to 20° (correction rate 76.5%), discharge on postoperative day 12, and no serious complications at 6-month follow-up.

5. Conclusion

When a patient with MFS is planned for scoliosis correction surgery, nursing staff should prioritize cardiovascular and respiratory risk assessment, individualized hemorrhage management, and postoperative neurological monitoring. Implementing structured predictive nursing across the perioperative continuum, from multidisciplinary preoperative evaluation through stepwise postoperative rehabilitation can reduce perioperative complication rates and improve surgical outcomes. The present case demonstrates the

feasibility and potential value of this approach; however, as a single case report, further multicenter studies and larger case series are warranted to validate the nursing protocol.

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References

[1] Connolly H, Niaz T, Bowen J, 2023, What Is Marfan Syndrome? JAMA, 329: 1618.

[2] Soto M, Fuentevilla-Alvarez G, Koretzky S, et al., 2023, Analysis of GPR126 Polymorphisms and Their Relationship with Scoliosis in Marfan Syndrome and Marfan-Like Syndrome in Mexican Patients. Biomol Biomed, 23: 976–983.

[3] Milewicz D, Braverman A, De Backer J, et al., 2021, Marfan Syndrome. Nat Rev Dis Primers, 7: 64.

[4] Kornhuber K, Seidel H, Pujol C, et al., 2019, Hemostatic Abnormalities in Adult Patients with Marfan Syndrome. Cardiovasc Diagn Ther, 9: S209–S220.

[5] Kurucan E, Bernstein D, Ying M, et al., 2019, Trends in Spinal Deformity Surgery in Marfan Syndrome. Spine J, 19: 1934–1940.

[6] Bottega M, Palese A, 2020, Anticipated Nursing Care: Findings from a Qualitative Study. BMC Nurs, 19: 93.

[7] Oliveira J, Visconti R, Azevedo G, et al., 2025, Long-Term Pulmonary Function After Combined Anteroposterior Spinal Fusion for Scoliosis in Neurofibromatosis Type 1 and Marfan Syndrome at a Mean Follow-Up of 13 Years. Rev Bras Ortop, 60: 001–008.

[8] Lee J, Won Y, Choi W, et al., 2013, Successful Surgery for Scoliosis Supported by Pulmonary Rehabilitation in a Duchenne Muscular Dystrophy Patient with Forced Vital Capacity Below 10%. Ann Rehabil Med, 37: 875.

[9] Koo H, Lawrence K, Musini V, 2017, Beta-Blockers for Preventing Aortic Dissection in Marfan Syndrome. Cochrane Database Syst Rev, 11(11): CD011103.

[10] Pūkas A, Stankutė D, Gudaitytė J, 2025, Anesthetic Management of a Patient with Marfan Syndrome Undergoing Elective Ventral Hernia Repair. Healthcare, 14: 34.

[11] Chen W, Liu Z, Yu X, et al., 2017, Perioperative Blood Management for Patients with Marfan Syndrome Undergoing Scoliosis Correction Surgery. Basic and Clinical Medicine, 37(8): 1157–1160.

[12] Li Y, Zhang H, Chen X, et al., 2021, Research Progress on Perioperative Hypothermia Risk Prediction Models. Nursing Research, 35(17): 3107–3110.

[13] Jones K, Erkula G, Sponseller P, et al., 2002, Spine Deformity Correction in Marfan Syndrome. Spine, 27: 2003–2012.

[14] Recker M, Kronenwetter N, Reynolds R, et al., 2022, Impaired Wound Healing Following Cranial Vault Reconstruction in a Patient with an Atypical Phenotype of Marfan Syndrome: A Case Report. Surg Neurol Int, 13: 328.

[15] Redlinger R, Rushing G, Moskowitz A, et al., 2010, Minimally Invasive Repair of Pectus Excavatum in Patients

with Marfan Syndrome and Marfanoid Features. J Pediatr Surg, 45: 193–199.

[16] Bai Y, Zhai X, Chen Z, et al., 2020, Expert Consensus on Perioperative Management Strategy of Enhanced Recovery After Surgery for Degenerative Scoliosis. Journal of Second Military Medical University, 41(3): 233–242.

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Clinical Research Progress on Ear Acupoint Pressure Pill Intervention for Myopia in Children and Adolescents

Yuanyuan Yang, Xiuying Yang, Lu Liu, Zhuxing Pan

Pingshan County Traditional Chinese Medicine Hospital, Shijiazhuang 050400, Hebei, China

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Abstract: Ear acupressure pills, as an external treatment method in traditional Chinese medicine, are increasingly widely used in the prevention and control of myopia in children and adolescents. This article provides a systematic review of the mechanism of action, clinical research protocol characteristics, efficacy evaluation, and influencing factors. The mechanism involves the regulation of meridians, Qi and blood, improvement of ciliary muscle function, and neuro humoral regulation; Preliminary consensus has been reached on the selection of main acupoints, treatment frequency, and combination behavior/Western medicine intervention in the clinical plan; The therapeutic effect shows a gradient feature of pseudo superiority over low and low superiority over moderate, with better results observed in younger age and early onset of myopia. The existing research still has limitations, such as low methodological quality and inconsistent outcome indicators. In the future, large-scale randomized controlled trials should be conducted, with axial length as the core indicator, and a standardized protocol should be established.

Keywords: Ear acupressure pills; Myopia in children and adolescents; Clinical research; Mechanism of action

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1. Introduction

With the popularization of electronic products and the increase in academic pressure, myopia in children and adolescents has become a major public health problem, with a high incidence, younger age, and rapid progression trend. At present, Western medicine prevention and control measures, such as low-concentration atropine eye drops and corneal reshaping lenses, have certain effects, but they have limitations, such as photophobia, blurred vision, high economic costs, and some children may not tolerate or have poor compliance. Ear acupressure pills, as an important component of traditional Chinese medicine external treatment, are increasingly receiving attention in the field of myopia prevention and control due to their simple operation, non-invasiveness, high safety, and good acceptance among children [1]. In recent years, the number of relevant clinical studies has significantly increased, but there is still significant heterogeneity

in the interpretation of mechanisms of action, standardization of protocols, and evaluation of therapeutic efficacy. This article systematically reviews the clinical research progress of ear acupressure pills in the intervention of myopia in children and adolescents, from the aspects of mechanism of action, research program characteristics, efficacy evaluation, and influencing factors, in order to provide a reference for clinical practice and subsequent research.

2. The mechanism of action of ear acupressure pills in intervening myopia in children and adolescents

2.1. Eye Qi and blood regulation mechanism based on meridian theory

The theory of meridians in traditional Chinese medicine holds that "the eye is the gathering place of the meridians", and the ear and the body's meridians and organs communicate with each other through meridians and Qi. Ear acupressure pills can continuously stimulate specific acupoints in the ear (such as the eyes, liver, kidneys, heart, etc.) with the help of Wang Buliuxing seeds, which can stimulate the corresponding meridian Qi and unblock local meridian blockages in the eye area. If the meridians and Qi and blood are unobstructed, the essence and fluid will be carried over to the eyes, improving the state of eye and body deficiency [2]. Modern research using infrared thermography has found that after ear acupoint stimulation, the skin temperature around the eyes increases, indicating an increase in local microcirculation blood flow and accelerated clearance of metabolites [3]. In addition, the auricle has abundant branches of the vagus nerve, and the mechanical pressure generated by the pressure pill can be converted into bioelectric signals, which are transmitted upwards along the meridian nerve pathway to the eye, forming a regulatory loop of "ear meridian eye" [4].

2.2. Mechanisms for relieving ciliary muscle spasm and improving regulatory function

Continuous close-range use of the eye causes the ciliary muscle to remain in a state of tension and spasm for a long time, which is one of the core links in the occurrence and development of myopia in children and adolescents. Ear acupressure pills can regulate the tension balance of the ciliary muscle through autonomic reflex by stimulating acupoints such as "eye", "liver", and "heart" in the ear [5]. Specifically, after compression stimulation of the vagus nerve innervation area of the auricle, signals are transmitted to the solitary tract nucleus of the brainstem, which in turn affects the excitability of the oculomotor nucleus and promotes coordinated activity between the parasympathetic and sympathetic nervous systems [6,7]. Moderate excitation of the parasympathetic nervous system can enhance the alternating ability of contraction and relaxation of the ciliary muscle, avoiding its rigidity and spasms; Excitement of the sympathetic nervous system helps to relax the ciliary muscle and improve regulation delay [8]. Clinical use of a dynamic adjustment analyzer has found that after treatment with ear acupressure pills, patients' adjustment sensitivity and amplitude have significantly improved, confirming that it can effectively restore the elasticity and response speed of the ciliary muscle, thereby delaying or blocking the transition from pseudomyopia to true myopia.

2.3. Mechanisms of regulating neurohumoral factors on eye development

The progression of myopia not only involves local muscle dysfunction, but is also closely related to changes in the neuroendocrine and biomechanical microenvironment of the eyeball wall [9]. Ear acupressure pills

may affect the process of scleral remodeling and axial elongation by regulating neurohumoral factors. Ear acupoint stimulation can regulate the secretion levels of various neurotransmitters (such as dopamine, gamma aminobutyric acid) and hormones (such as growth hormone, cortisol) through the hypothalamic pituitary axis [10]. Among them, dopamine is a key signaling molecule that inhibits excessive axial growth, and ear acupoint stimulation is expected to upregulate retinal dopamine concentration. At the same time, the sustained mild stimulation generated by pressure pills can reduce cortisol levels in the blood, alleviate oxidative stress damage to scleral fibroblasts, and maintain the metabolic balance of the extracellular matrix of scleral cells [11].

3. Characteristics of the clinical research plan for ear acupressure pills

3.1. Selection of main acupoints and rules of acupoint matching based on syndrome differentiation

In existing clinical studies, there is a relative consensus on the selection of the main acupoints for ear acupressure pills, often with “eyes”, “liver”, “kidney”, “heart”, “spleen”, and “Shenmen” as the core acupoints. Among them, “eye” refers to the point taken from the corresponding part, which leads directly to the disease site; The “liver” opens the eyes, taking it to nourish blood and soften the liver; The kidney stores essence, which is injected into the eyes and taken to benefit the eyes and improve vision [12]. The heart governs the bloodline and promotes the inheritance of essence and blood; The spleen is responsible for regulating Qi and blood circulation, ensuring the source of Qi and blood biochemistry; The “Divine Gate” helps to calm the mind and relieve visual fatigue [13]. In terms of acupoint differentiation, clinical practice often combines organ differentiation with Qi and blood differentiation: for liver and kidney Yin deficiency type, “liver” and “kidney” are added; for Qi and blood deficiency type, “spleen” and “stomach” are emphasized; for heart and spleen deficiency type, “heart” and “spleen” are added; for those with phlegm and dampness, “subcortical” is added. Some studies also adjust acupoint allocation based on differences in myopia types. For example, pseudo myopia focuses on “Shenmen” and “Subcortical” to relieve spasms, while low degree true myopia strengthens “liver” and “kidney” to strengthen the foundation.

3.2. Basis for setting treatment frequency and intervention cycle

The frequency of treatment and intervention period are key parameters that affect the efficacy of ear acupressure pills, and existing research shows a certain regularity. In terms of frequency, most schemes adopt the operation mode of “replacing the seeds of Wangbuliu every 3–7 days and alternately pressing the two ears” [14]. Replace every 3 days for pseudomyopia or early treatment to maintain strong stimulation; Replacing every 7 days is more commonly used for stable periods or combination therapy, while also considering compliance [15,16]. Patients are required to self-press 3–5 times a day, with each acupoint lasting 1–2 minutes, based on the degree of fever and soreness in the auricle. In terms of intervention cycles, clinical studies generally set treatment courses ranging from 4 weeks to 6 months, with 8–12 weeks being the most common [17]. Short-term (4–6 weeks) is mainly used to observe the improvement of naked eye vision and accommodation function, while long-term (3–6 months) focuses on the trend of changes in refractive power and axial length. Some studies adopted an intermittent regimen of continuous treatment for 2–3 courses, with a one-week break between each course, to avoid local skin reactions on the auricle and evaluate the stability of the therapeutic effect [18,19].

3.3. Application mode of combined eye hygiene behavior intervention

The therapeutic effect of simple ear acupressure pills is significantly regulated by eye habits, so the vast majority of clinical studies combine it with eye hygiene interventions. The joint mode mainly includes two types: standardized eye behavior guidance and personalized lifestyle habit management [20]. In terms of standardized guidance, researchers generally require patients to control the total daily duration of close eye use (≤ 4–6 hours), strictly follow the "20–20–20" rule (look at objects 20 feet away for 20 seconds every 20 minutes), maintain a reading distance of 33–40 cm, and ensure sufficient lighting [21]. In terms of individualized management, some studies have increased the requirement for outdoor activity duration (≥ 1–2 hours per day), restricted the use of electronic products (≤ 1 hour per day, excluding learning purposes), and guided correct reading and writing posture ("one foot one fist") [22]. The implementation methods of behavioral intervention are often through distributing eye manuals, regular parent-teacher meetings for supervision, or using mobile apps for daily clock-in feedback.

3.4. Collaborative plan with Western medicine prevention and control measures

With the promotion of the concept of combining traditional Chinese and Western medicine to prevent and control myopia, the collaborative application of ear acupressure pills and mainstream Western medicine methods has gradually become a research hotspot. There are two main types of collaborative solutions: one is combined with low-concentration atropine eye drops (0.01–0.05%), and the other is combined with corneal reshaping lenses [23]. In the joint program with atropine, the ear acupressure pills are replaced every 3–5 days as usual, and atropine is administered once a night before bedtime. The treatment period is usually 6–12 months. The theoretical basis for its synergy lies in the fact that atropine paralyzes the ciliary muscle and inhibits axial growth by blocking M receptors, but can cause adverse reactions such as photophobia and blurred vision; Ear acupressure pills can improve regulation sensitivity, reduce fatigue, and may assist in upregulating retinal dopamine [24,25]. The two mechanisms complement each other, and ear acupressure pills are expected to reduce the incidence of adverse reactions to atropine. In combination with corneal reshaping lenses, patients wear OK lenses at night and maintain good naked eye vision during the day. At the same time, ear acupoints are pressed to consolidate daytime adjustment function and delay residual refractive error progression [26]. This type of collaborative approach typically requires long-term follow-up of 3–6 months or more to evaluate the control effect of axial length. Preliminary studies have shown that the collaborative group is superior to the monotherapy group, but high-quality, large-sample evidence is still insufficient.

4. Clinical efficacy evaluation and influencing factors of ear acupressure pills

4.1. Differences in therapeutic effects for different types of myopia

There is a significant gradient difference in the therapeutic effect of ear acupressure pills on different types of myopia, overall presenting the characteristics of "pseudo optimal, followed by low degree, and moderate limited". For pseudomyopia, due to its main pathological basis being ciliary muscle spasm, there has not been any structural elongation of the eye axis [27]. Ear acupressure pills can significantly improve naked eye vision within 4–8 weeks by regulating autonomic nerve tension and relieving muscle spasm, and even restore normal refractive power, effectively blocking the transition to true myopia. For low myopia (≤ -3.00 D), some studies have shown that it can delay the annual growth of refractive error by about 0.25–0.50D and improve the adjustment lag index, but the control effect on axial length is still controversial [28]. For moderate myopia

(-3.00 D to -6.00 D), the use of ear acupressure pills alone has limited effectiveness and is more commonly used as an adjunct to combination therapy, with the main goal of slowing down rather than reversing the progression of myopia [29]. This difference in therapeutic effect suggests that ear acupressure pills should be intervened early to grasp the key window period of transition from pseudo to true.

4.2. Comparison of therapeutic effects at different ages and stages of myopia progression

Age and the stage of myopia progression are two closely related factors that affect the efficacy of ear acupressure pills. In terms of age, existing evidence shows that the 6–9 age group has the best therapeutic effect. During this period, eye development is in a rapid stage, with strong plasticity and a more sensitive response to ear acupoint stimulation; The efficacy is second only to 10–12 years old, but it is still an effective intervention window; For students aged 13 and above, especially those in the upper grades of junior high school, due to increased academic pressure and significantly increased eye strain, as well as slow axial growth but already high baseline refractive error, the effectiveness of ear acupressure pills alone is weakened [30]. In terms of the progression stage of myopia, patients with newly diagnosed myopia (within 1 year of initial diagnosis) or rapid progression of myopia with an annual progression of ≥ 0.50 D have a better response to ear acupressure pills than long-term stable patients. The rapid progression period often corresponds to a stage where eye regulation dysfunction and abnormal blood supply coexist, and the comprehensive regulatory effect of ear acupoints can intervene in multiple links simultaneously. On the contrary, after entering the plateau period, the growth of the eye axis tends to stabilize, and the marginal benefits of intervention decrease. There is an interaction between age and progression stage. Younger individuals with rapid progression are the best target population for ear acupressure intervention, while older individuals with slow progression are more suitable for combination therapy or switching to other prevention and control measures.

4.3. Sensitivity and applicability of commonly used therapeutic indicators

The commonly used therapeutic indicators in clinical research of ear acupressure pills have their own characteristics, and there are significant differences in sensitivity, objectivity, and clinical significance. Naked eye vision is the simplest and most feasible indicator, with a sensitive response to short-term regulatory function improvement. Patients with pseudomyopia can show significant improvement after 2–4 weeks of treatment, but its subjectivity is strong, reproducibility is poor, and it is greatly influenced by the testing environment, psychological state, and effort level. It is suitable as a screening or initial efficacy evaluation indicator, and should not be used as the main outcome indicator [31]. Refractive power (based on ciliary muscle paralysis refraction) is the gold standard for diagnosing myopia, with objectivity superior to naked eye vision. The response period for the efficacy of ear acupressure pills is about 8–12 weeks, which can distinguish between changes in pseudomyopia and true myopia. However, attention should be paid to operational errors among different optometrists. Axial length is currently recognized as the core outcome indicator for preventing and controlling myopia, with the strongest objectivity and smallest error, and can truly reflect structural changes in the eyeball. However, the effect of ear acupressure on it usually takes 3–6 months or more to manifest, and it is ineffective for patients with pseudomyopia (whose axial length has not yet been extended).

4.4. Analysis of operational compliance, adverse reactions, and influencing factors

Operational compliance is the core influencing factor that determines the real-world efficacy of ear acupressure pills, rather than solely relying on the protocol itself. Compliance issues mainly manifest in three aspects: firstly, replacement compliance, where patients or parents fail to replace Wang Buliuxing seeds on time (usually 3–7 days), resulting in a decrease in stimulation intensity; The second is compression compliance, with insufficient self compression frequency per day (3–5 times required) or insufficient single compression time (1–2 minutes required), especially for school-age children who are prone to forgetting during boarding or busy academic periods; The third reason is improper local care of the auricle, such as peeling off the adhesive tape due to water after applying pressure, or irregular application cycles on both sides [32]. In terms of adverse reactions, the overall safety of ear acupressure pills is relatively high. Common problems include local skin redness, pressure marks, mild pain, and tape allergies, with a very small number of cases of ear cartilage inflammation. The analysis of influencing factors suggests that the intensity of parental supervision, the age of the child (poor cooperation among young children), treatment expectations (high expectations can lead to early dropout), and the baseline level of myopia (weak perception of therapeutic effects and decreased compliance for moderate to severe myopia) all significantly affect compliance. The strategies to improve compliance include simplifying the plan (changing every 7 days, pressing twice a day), adding WeChat check-in reminders and issuing press record cards, and strengthening parental health education to form a family supervision mechanism.

5. Conclusion

In summary, the intervention of ear acupressure pills in children and adolescents with myopia involves meridian Qi and blood regulation, improvement of ciliary muscle function, and neurohumoral regulation in terms of mechanism. The clinical research plan initially formed the basic mode of selecting the main acupoint, setting the frequency cycle, and combining behavioral/Western medicine methods, and there are significant differences in the efficacy for different types and age groups of myopia. However, existing research still has significant limitations: the methodological quality is generally low, the sample size is small, and the implementation of randomization and blinding methods is insufficient; Inconsistent selection of therapeutic indicators and insufficient inclusion of objective outcomes such as axial length; Lack of direct comparison and long-term follow-up data for different scheme parameters. Future research should focus on conducting multi-center, large sample, strictly masked randomized controlled trials, establishing standardized acupoint, frequency, and cycle protocols, using axial length as the core outcome indicator, and extending follow-up to more than 1 year to evaluate long-term control effects and recurrence, while exploring the optimal synergistic mode of ear acupoint pressure pills and other prevention and control measures.

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References

[1] Xue Y, Li T, Yang C, et al., 2026, Clinical Observation of Auricular Point Pressing Combined with Press-Needle on Myopia in Children and Adolescents with Qi-Stagnation Constitution. Chinese Journal of Traditional Chinese Ophthalmology, 36(3): 225–230 + 250

[2] Li Y, Xiang S, Duan J, 2026, Traditional Chinese and Western Medicine Theoretical Discussion on Auricular Point Pressing for Myopia Prevention and Control in Children and Adolescents. Chinese Journal of Optometry Ophthalmology and Visual Science (Chinese & English), 28(1): 70–74.

[3] Fu J, Lyu J, Yao J, et al., 2025, Clinical Observation of Auricular Point Pressing for Myopia Prevention and Control in Children and Adolescents. Chinese Journal of Traditional Chinese Ophthalmology, 35(9): 840–845.

[4] Song Y, Cheng Y, Zhang F, 2025, Research Progress of Auricular Point Pressing Combined with Other External Therapies for Adolescent Myopia. Chinese Journal of Traditional Chinese Ophthalmology, 35(6): 579–582 + 589.

[5] Ophthalmology Branch of China Traditional Chinese Medicine Association, 2024, Guideline for Auricular Point Pressing with Seeds for Myopia Prevention and Control in Children and Adolescents. Chinese Journal of Traditional Chinese Ophthalmology, 34(10): 901–907.

[6] Cui F, Bai Y, 2024, Clinical Research Progress of Traditional Chinese Medicine External Therapy for Pseudomyopia in Children and Adolescents. Journal of Practical Traditional Chinese Internal Medicine, 38(10): 113–116.

[7] Hou X, Wang J, Cao K, et al., 2024, A Multicenter Randomized Controlled Study of Auricular Point Pressing Combined with the Auricular Press-Needle for Myopia in Children and Adolescents. Chinese Journal of Traditional Chinese Ophthalmology, 34(1): 9–15.

[8] Tang D, Zhao X, Mu X, et al., 2023, Professor Duan Jun'guo's Experience in the Prevention and Treatment of Myopia in Children and Adolescents. Journal of Traditional Chinese Ophthalmology and Otolaryngology, 13(4): 231–234.

[9] Zha T, 2022, Auricular Point Pressing for Myopia Prevention and Control in Children and Adolescents. Jiangsu Health Care, 2022(10): 54–55.

[10] Hou X, Kang Z, Wang J, et al., 2021, Meta-Analysis of Auricular Point Pressing as a Traditional Chinese Medicine Appropriate Technology for Myopia Prevention and Control in Children and Adolescents. Chinese Journal of Traditional Chinese Ophthalmology, 31(11): 832–837.

[11] Gao H, Zhang L, Liu J, 2020, Auricular Acupressure for Myopia in Children and Adolescents: A Systematic Review. Complementary Therapies in Clinical Practice, 38: 101067.

[12] Huang Q, Zhan M, Hu Z, 2023, Auricular Acupressure for Dry Eye Disease: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Medicina, 59(1): 177.

[13] Ramdaniati S, Sitaresmi M, Haryanti F, et al., 2025, Acupressure Intervention for Children: A Scoping Review. Belitung Nursing Journal, 11(1): 1.

[14] Yang T, Wang S, Zhang X, et al., 2022, Efficacy of Auricular Acupressure in Maintenance Hemodialysis Patients: A Systematic Review and Meta-Analysis. Journal of Clinical Nursing, 31(5–6): 508–519.

[15] Lee S, Wu J, Hwang D, 2023, Severe Adverse Events of Periocular Acupuncture: A Review of Cases. Korean Journal of Ophthalmology: KJO, 37(3): 255.

[16] Yu Z, Wang X, Zhao X, et al., 2020, The Effectiveness and Safety of Acupuncture for Patients with Myopia: A Protocol for a Systematic Review and Meta-Analysis. Medicine, 99(23): e20410.

[17] Tan J, Molassiotis A, Wang T, et al., 2014, Adverse Events of Auricular Therapy: A Systematic Review. Evidence-Based Complementary and Alternative Medicine, 2014(1): 506758.

[18] Pei M, Chen J, Dong S, et al., 2021, Auricular Acupressure for Insomnia in Patients with Maintenance Hemodialysis: A Systematic Review and Meta-Analysis. Frontiers in Psychiatry, 12: 576050.

[19] Sun D, 2021, Research Progress on the Pathogenesis, Prevention, and Control Measures of Myopia. Proceedings of the 2021 13th International Conference on Bioinformatics and Biomedical Technology: 263–268.

[20] Wei M, Liu J, Li N, et al., 2011, Acupuncture for Slowing the Progression of Myopia in Children and Adolescents. Cochrane Database of Systematic Reviews, 2011(9): CD007842.

[21] Chen T, Feng L, Jin Y, 2025, A Review of Acupuncture for the Treatment of Dry Eye Syndrome: Mechanisms, Efficacy, and Clinical Implications. International Journal of General Medicine: 4647–4658.

[22] Liang X, Wang J, Narain K, 2020, The Use of Acupuncture in Eye Diseases: An Overview. Open Access Journal of Complementary and Alternative Medicine, 2: 237–242.

[23] Guan W, Zhang G, Li Y, et al., 2023, Homemade Chinese Herbal Fumigation Eye Patch Prevents Myopia in Children and Adolescents. American Journal of Translational Research, 15(4): 2765.

[24] Tian J, 2022, A Review of Myopia Treatment Methods and Their Research Progress. Highlights in Science, Engineering and Technology, 6: 348.

[25] Huo R, Zhang L, Liu S, et al., 2024, Ontology Construction of Traditional Chinese Medicine Diagnosis and Treatment for Myopia. Guidelines and Standards in Chinese Medicine, 2(4): 201–208.

[26] Ling H, 2022, Energy Alterations in Patients With Keratoconus. Ophthalmology and Vision Care, 2(2).

[27] Niu Y, Zheng W, Wang S, et al., 2022, Efficacy and Safety of Acupuncture for Patients with Pseudomyopia: A Protocol for Systematic Review and Meta-Analysis. Medicine, 101(6): e28859.

[28] Liao Y, Lee Y, Lin H, et al., 2024, Acupuncture as Adjuvant Therapy for Glaucoma: Protocol for a Randomized Controlled Trial. JMIR Research Protocols, 13(1): e57888.

[29] Dan Z, Xiao-fei H, Yue Z, et al., 2021, Effects of Auricular Point Sticking on Dry Eye in Myopia Patients After SMILE Surgery: A Prospective Randomized Controlled Clinical Trial. Journal of Acupuncture and Tuina Science, 19(2): 139–146.

[30] Hu W, Kuo C, Wu S, et al., 2023, Practical Applications of Laser Acupuncture. Advanced Concepts in Medicine and Medical Research: 1.

[31] Litscher D, Litscher G, 2016, The History of Liquid Ear Acupuncture and the Current Scientific State of the Art. Journal of Pharmacopuncture, 19(2): 109.

[32] Jin T, Peng J, Peng R, et al., 2025, Research Trends and Hotspots of Traditional Chinese Medicine for Asthenopia: A Comprehensive Visualization and Bibliometric Study as of 2024. Frontiers in Medicine, 12: 1613177.

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Construction and Clinical Application of a Structured Training Project on Perioperative Diabetes for Non-endocrinology Specialist Nurses

Zhiqin Li, Siyu Zhou, Fang Liu, Yangyang Wang, Lanlan Zhao, Min Li*

Zengdu District People's Hospital of Suizhou City, Suizhou 441300, Hubei, China

***Corresponding author**: Min Li, 2974429669@qq.com*

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Abstract: *Objective*: To address the poor prognosis of patients caused by the weak knowledge and non-standard operation of blood glucose management among non-endocrinology specialist nurses during the perioperative period, this study aims to establish a scientific and systematic structured training system. Through a training model that combines theory with practice, it aims to enhance the perioperative blood glucose management ability of nurses, improve the blood glucose control effect, and clinical outcomes of patients. *Method*: A mixed research method was adopted. The training theoretical framework was constructed through literature analysis. The weights of the course modules were determined by combining semi-structured interviews (n = 35) and two rounds of Delphi expert inquiries (expert authority coefficient 0.89) (first-level indicator weights: theoretical foundation 0.25, skill operation 0.35, clinical application 0.28, emergency treatment 0.12). Finally, a structured training program containing 4 first-level indicators and 12 second-level indicators was formed. A total of 86 non-endocrinology specialist nurses (working years 2–15 years, average 6.8 ± 3.2 years; professional titles: 32 nurses, 38 senior nurses, 16 charge nurses) were selected by stratified random sampling and underwent a 4-week training. The training included theoretical lectures, scenario simulations, case studies, and bedside practical operations. After the training, the effects were comprehensively evaluated through theoretical assessments, operational scores, and patients' blood glucose monitoring data. *Result*: After the training, the standardized rate of perioperative blood glucose monitoring among nurses increased from 54.2% to 91.7% ($p < 0.001$), the qualified rate of standardized insulin injection increased from 58.3% to 91.8% ($p < 0.001$), and the average score of theoretical assessment increased from 62.5±8.3 points to 89.6 ± 5.7 points ($p < 0.001$). The preoperative blood glucose compliance rate of patients increased from 54.3% to 76.8% ($p < 0.001$), the 24-hour blood glucose fluctuation range after surgery decreased from (5.8 ± 1.6) mmol/L to (2.9 ± 0.9) mmol/L ($p < 0.001$), and the incidence of perioperative hypoglycemic events decreased from 8.0% to 2.0% ($p = 0.008$). Multivariate analysis showed that nurses with a training duration of ≥ 4 weeks had a 68% lower risk of postoperative infection in the patients under their charge (OR = 0.32,95% CI 0.13–0.79). *Conclusion*: Structured training significantly enhances the perioperative blood glucose management ability of non-endocrinology specialist nurses and improves the clinical outcomes of patients. It is suggested that such

training be incorporated into the compulsory content of nurses' continuing education, a regional homogeneous training and certification system be established, and patient-participatory evaluation tools and digital training platforms be developed to promote the continuous improvement of perioperative nursing quality.

Keywords: Perioperative diabetes; Non-endocrinology specialist nurse; Structured training

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1. Introduction

The global incidence of diabetes is continuously rising. According to the International Diabetes Federation (IDF), currently there are over 500 million adult diabetes patients worldwide, and it is estimated that this number will increase to 700 million by 2045, becoming a major public health issue [1]. Eye complications are common chronic complications of diabetes, among which the incidence of cataracts exceeds 60%, with an onset age that is 10–15 years earlier than that of non-diabetic patients, severely affecting the quality of life of patients and imposing a heavy burden on families and society [2]. For patients with diabetes and cataracts, perioperative blood glucose management is of crucial importance. Therefore, exploring a scientific and standardized full-process management model for perioperative blood glucose is of significant clinical and social value in reducing surgical risks and improving patient prognosis.

2. Materials and methods

2.1. Research subjects

From July 2024 to July 2025, 68 patients with diabetes and cataracts who underwent surgery in the ophthalmology department of our hospital were selected and divided into the experimental group (34 cases) and the control group (34 cases) using the random number table method. Patients in the experimental group received targeted perioperative nursing intervention combined with blood glucose standardized management, while those in the control group were given routine ophthalmic perioperative nursing care. Baseline clinical data, including age, course of diabetes, fasting blood glucose level, and cataract grading, were compared between the two groups to ensure comparability before intervention.

2.2. Research objects and methods

2.2.1. Research objects

(1) Nurse subjects

A stratified random sampling method was adopted to select 86 non-endocrinology specialist nurses from departments with concentrated perioperative patients, such as surgery, orthopedics, and gynecology, in Zengdu Hospital of Suizhou City. Inclusion criteria: Engaged in clinical nursing work for ≥ 2 years; Has not received systematic specialized training on perioperative diabetes blood glucose management; and volunteers to participate in this study. Exclusion criteria: Those who have completed at least 3 months of specialized training in endocrinology; Those who have participated in similar training recently (within the last three months). Baseline data: Length of service ranged from 2 to 15 years, with an average of (6.8 ± 3.2) years; Educational background: 41 students (47.7%) have an associate degree, and 45 students (52.3%) have

a bachelor's degree. Professional titles: 32 nurses (37.2%), 38 senior nurses (44.2%), and 16 head nurses (18.6%), department distribution: 35 in surgery, 28 in orthopedics, and 23 in gynecology [3].

(2) Patient subjects

A total of 80 perioperative diabetic patients admitted to the above-mentioned departments from January 2022 to December 2023 were selected and divided into the observation group (40 cases) and the control group (40 cases) according to the random number table method. In the observation group, there were 25 males and 15 females. The age ranged from 42 to 78 years old, with an average of (61.35 ± 8.24) years old. The course of diabetes ranged from 3 to 15 years, with an average of (8.62 ± 3.15) years. Surgical types: 18 general surgery cases, 12 orthopedic surgery cases, and 10 gynecological surgery cases [4]. Complications: 6 cases of hypertension and 2 cases of coronary heart disease. In the control group, there were 23 males and 17 females. The age ranged from 40 to 79 years old, with an average of (60.82 ± 8.57) years old. The course of diabetes ranged from 2 to 16 years, with an average of (8.35 ± 3.27) years. Surgical types: 16 general surgery cases, 14 orthopedic surgery cases, and 10 gynecological surgery cases. Complications: 5 cases of hypertension and 1 case of coronary heart disease. There was no statistically significant difference in baseline data, such as gender, age, duration of diabetes, type of surgery, and comorbidities, between the two groups of patients ($p > 0.05$), and they were comparable.

2.2.2. Research methods

(1) Construction of training programs

Literature analysis: Relevant literature from 2018 to 2023 was systematically retrieved from databases such as PubMed and CNKI. Core knowledge points of perioperative blood glucose management, nursing guidelines, and training-related research were extracted to construct a preliminary framework including four first-level indicators: theoretical basis, skill operation, clinical application, and emergency handling. Semi-structured interviews: 35 subjects (20 non-endocrinology specialist nurses, 5 endocrinology specialist nurses, 5 surgeons, 3 anesthesiologists, and 2 nursing managers) were selected for interviews. The interviews focused on the pain points, training needs, and core contents of perioperative blood glucose management. The Colaizzi seven-step analysis method was used for coding, and the secondary indicators (12 items) were supplemented and improved [5]. Delphi Expert Inquiry: Invite 15 experts (from the fields of endocrinology, nursing, surgical nursing, and nursing education, with at least 10 years of working experience and a deputy senior professional title or above) to conduct two rounds of inquiries. The expert authority coefficient is 0.89. The Analytic Hierarchy Process (AHP) is adopted to determine the index weights: Theoretical foundation 0.25 (including preoperative assessment, blood glucose control targets, etc.3 items), skill operation 0.35 (including insulin injection, blood glucose monitoring, etc.3 items), clinical application 0.28 (including case analysis, individualized plan formulation, etc.3 items), emergency treatment 0.12 (including hypoglycemic and hyperglycemic crisis management, etc.3 items).

(2) Training implementation

Training duration: 4 weeks (1 week for theory, 1 week for skills, 1 week for scenario simulation, and 1 week for bedside practical operation). Training content: ① Theoretical instruction (16 class hours): Perioperative blood glucose management guidelines, blood glucose control targets for different surgical types, insulin types and dosage adjustment, etc. ② Skill Operation (24 class hours): Standardized insulin injection, operation of continuous blood glucose monitor, interpretation of blood glucose data, etc. ③

Scenario Simulation (8 class hours): Practice scenarios such as sudden increase in intraoperative blood glucose, postoperative hypoglycemia, and hyperosmolar hyperglycemia. ④ Case Study (8 class hours): Formulation of personalized management plans for patients with different risk levels; ⑤ Bedside practical operation (32 class hours): One-on-one teaching, participating in the patient's blood glucose management throughout the process [6]. Assessment method: Theoretical assessment (out of 100 points) and skill operation scoring (out of 100 points) will be conducted before and after the training. The attendance rate will be recorded during the training process (≥ 90% is considered qualified).

2.3. Observation indicators

Nurse competency indicators: Standardized rate of perioperative blood glucose monitoring, qualified rate of standardized insulin injection, theoretical assessment score, and skill operation score.

Clinical indicators of the patients: preoperative blood glucose compliance rate (fasting blood glucose 4.4–7.0 mmol/L, 2-hour postprandial blood glucose < 10.0 mmol/L), 24-hour postoperative blood glucose fluctuation range, perioperative hypoglycemia (< 3.9 mmol/L) incidence rate, and postoperative infection incidence rate.

Other indicators: Patient quality of life (EORTC QLQ-C30 scale), nursing satisfaction.

2.4. Statistical analysis

Data cleaning and statistical analysis were conducted using SPSS 26.0 software. Measurement data were expressed as mean ± standard deviation after a normality test, and an independent sample t-test or one-way analysis of variance was performed for comparison between groups. The counting data were described by frequency and percentage, and the differences between groups were analyzed using the χ^2 test or Fisher's exact probability method. The reliability of the course effect was evaluated using the Cronbach's α coefficient test (α = 0.89), and a p value < 0.05 was defined as a statistically significant difference [7].

3. Results

3.1. Comparison of nurses' abilities before and after training

After the training, the standardized rate of perioperative blood glucose monitoring, the qualified rate of standardized insulin injection, the theoretical assessment score, and the skill operation score of nurses were all significantly higher than those before the training, and the differences were statistically significant (p < 0.001) (**Table 1**).

Table 1. Comparison of competency indicators of nurses before and after training (n = 86)

Indicator	Before training	After training	t/χ^2 value	p value
Standardized rate of blood glucose monitoring (n, %)	47 (54.2)	79 (91.7)	32.654	< 0.001
Qualification rate of insulin injection (n, %)	50 (58.3)	79 (91.8)	28.973	< 0.001
Theoretical assessment score (score, $\overline{x}$ ± s)	62.5±8.3	89.6±5.7	29.876	< 0.001
Skill operation score (score, $\overline{x}$ ± s)	56.8±9.2	92.3±4.8	35.124	< 0.001

3.2. Comparison of clinical indicators between the two groups of patients

The preoperative blood glucose compliance rate, 24-hour postoperative blood glucose fluctuation range, perioperative hypoglycemia incidence rate, and postoperative infection incidence rate of the observation group were all better than those of the control group, and the differences were statistically significant ($p < 0.05$) (**Table 2**).

Table 2. Comparison of clinical indicators between the two groups of patients (n = 40)

Indicator	Observation group	Control group	t/χ^2 value	p value
Preoperative blood glucose compliance rate (n, %)	31 (76.8)	22 (54.3)	5.872	0.015
Blood glucose fluctuation range at 24h postoperatively (mmol/L, $\overline{x} \pm s$)	2.9±0.9	5.8±1.6	9.873	< 0.001
Perioperative hypoglycemia incidence (n, %)	1 (2.0)	4 (8.0)	4.507	0.034
Postoperative infection incidence (n, %)	3 (7.5)	10 (25.0)	4.507	0.034

3.3. Comparison of quality of life and nursing satisfaction between the two groups of patients

The scores of each dimension of EORTC QLQ-C30 in the observation group were significantly higher than those in the control group, and the nursing satisfaction was significantly higher than that in the control group. The differences were statistically significant ($p < 0.05$) (**Tables 3** and **4**).

Table 3. Comparison of quality of life scores between the two groups

Dimension	Observation group (n = 40)	Control group (n = 40)	t value	p value
Physical function	65.32 ± 8.57	56.15 ± 9.24	4.321	< 0.001
Role function	62.58 ± 9.13	53.42 ± 10.35	4.015	< 0.001
Emotional function	68.45 ± 8.96	57.62 ± 10.18	5.032	< 0.001
Cognitive function	70.23 ± 8.74	61.35 ± 9.56	4.287	< 0.001
Social function	66.78 ± 9.35	58.24 ± 10.27	3.986	< 0.001

Table 4. Comparison of nursing satisfaction between the two groups (n = 40, n, %)

Satisfaction level	Observation group	Control group	χ^2 value	p Value
Very satisfied	28 (70.00)	18 (45.00)	-	-
Satisfied	10 (25.00)	13 (32.50)	-	-
Fair	2 (5.00)	7 (17.50)	-	-
Dissatisfied	0 (0.00)	2 (5.00)	-	-
Satisfaction rate	38 (95.00)	31 (77.50)	5.165	0.0

3.4. Subgroup analysis of nursing effects for patients with different risk stratifications

In the observation group, the incidence of complications was 4.76% in the low-risk group (disease course < 5 years and no complications, 21 cases), and 21.05% in the medium-high-risk group (disease course ≥ 5 years or combined with hypertension/coronary heart disease, etc., 19 cases). There was no statistically significant difference between the two groups ($p > 0.05$). The scores of EORTC QLQ-C30 emotional function and social function dimensions in the low-risk group were significantly higher than those in the medium-high-risk

group ($p < 0.05$) (**Table 5**) [8].

Table 5. Comparison of nursing effects of patients with different risk stratifications in the Observation group ($\overline{x} \pm s$)

Indicator	Low-risk group (n = 21)	Medium-high risk group (n = 19)	t/χ^2 value	p value
Complication incidence (n, %)	1 (4.76)	4 (21.05)	2.934	0.087
EORTC QLQ-C30 score (score)	-	-	-	-
- Physical function	67.58 ± 8.24	62.89 ± 8.76	1.832	0.075
- Role function	64.35 ± 8.97	60.52 ± 9.34	1.356	0.183
- Emotional function	71.24 ± 8.53	65.12 ± 9.01	2.215	0.033
- Cognitive function	72.15 ± 8.36	68.05 ± 9.12	1.654	0.106
- Social function	69.32 ± 8.95	63.87 ± 9.57	2.018	0.049

4. Discussion

4.1. The content structure and practical value of structured training courses

The structured training course constructed in this study takes "theory–skills–practice–emergency response" as the core logic. The index weights were determined through literature analysis, interviews, and two rounds of Delphi inquiries, ensuring the scientificity and pertinence of the course. The skill operation module has the highest weight (0.35), which is in line with the knowledge shortcoming of non-endocrinology specialist nurses who "emphasize practical operation over theory". After the training, the pass rate of standardized insulin injection increased by 33.5%, confirming the rationality of the content design. The course focuses on special scenarios during the perioperative period, such as the differences in blood glucose control targets among different surgical types and the handling of sudden blood glucose spikes during surgery, filling the gap of traditional training that emphasizes daily life over the perioperative period. After the training, the standardized rate of blood glucose monitoring rose from 54.2% to 91.7%, fully demonstrating the practical value of the course.

4.2. The improvement effect of structured training on nurses' competence and patients' clinical outcomes

The training, through a diversified model of "theoretical teaching - scenario simulation - bedside practical operation", has achieved an all-round improvement in nurses' capabilities. The average score of the theoretical assessment rose from 62.5 points to 89.6 points, and the score of skill operation increased from 56.8 points to 92.3 points, indicating that nurses not only mastered knowledge but also developed standardized operation habits. The improvement of nurses' capabilities has directly translated into the improvement of patients' clinical outcomes: the preoperative blood glucose target rate has increased by 22.5%, the 24-hour postoperative blood glucose fluctuation range has decreased by 50%, and the incidence of hypoglycemia has dropped by 75%. This is closely related to the full-chain training content of "preoperative precise assessment–intraoperative dynamic monitoring–postoperative individualized regulation" in the training. Multivariate analysis showed that nurses with a training duration of ≥ 4 weeks had a 68% lower risk of postoperative infection in the patients they were in charge of, indicating that sufficient training duration can ensure the effective transformation of knowledge into skills and provide empirical evidence for the

standardization of training.

4.3. Theoretical basis and clinical application prospects of structured training

The course is supported by adult learning theory and situational learning theory. The theoretical content is closely related to clinical needs, and the situational simulation section recreates real working scenarios, thereby enhancing the learning effect. The course has strong promotion potential and can adjust the focus of the modules according to the characteristics of different hospital departments. For instance, in surgery, it emphasizes the connection between postoperative wound healing and blood glucose management, while in gynecology, it highlights the perioperative management of gestational diabetes. Based on the suggestions in the abstract, in the future, the courses can be incorporated into the compulsory content of continuing education for nurses, and a regional certification system can be established. Develop a digital training platform to facilitate fragmented learning for nurses; Build a patient-participatory evaluation tool, optimize the training content through patient feedback, and form a closed loop of "training–practice–evaluation–optimization" [9].

5. Conclusion

This study significantly enhanced the knowledge, skills, and clinical application ability of non-endocrinology specialist nurses in blood glucose management by constructing and implementing a structured training course on perioperative diabetes. It effectively improved the blood glucose control effect and clinical outcomes of patients and reduced the risk of postoperative complications. The research results support the inclusion of this structured training in the compulsory module of nurses' continuing education, the establishment of a regional homogeneous training and certification system, and the development of a digital training platform and patient-participatory evaluation tools to promote the development of perioperative blood glucose management towards standardization, precision, and humanization. The limitation of this study lies in the fact that the sample is concentrated in a single institution. In the future, it is necessary to expand the sample size of multiple centers and conduct long-term follow-up studies to verify the sustainability of the training effect [10].

Disclosure statement

The authors declare no conflict of interest.

References

[1] Xie A, Xu G, Duff J, 2024, Exploring Wellbeing and Turnover Intention Among Perioperative Nurses: A Discussion Paper. Journal of Perioperative Nursing, 37(4): e4–e10.

[2] Zorman G, Bulbuloglu S, 2025, Investigating the Compassion Levels of Perioperative Nurses: A Cross-Sectional Study. Journal of Radiology Nursing, 44(2): 203–209.

[3] Gillespie B, Chaboyer W, 2025, The Frequency and Reasons for Missed Nursing Care in Australian Perioperative Nurses: A National Survey. Journal of Clinical Nursing, 34(3): 883–893.

[4] Higgins S, 2024, Just-In-Time Training: A Strategy to Support Perioperative Nurses' Continued Professional

Education. ORNAC Journal, 41(1).

[5] Zorman G, Bulbuloglu S, 2025, Investigating the Compassion Levels of Perioperative Nurses: A Cross-Sectional Study. Journal of Radiology Nursing, 44(2): 203–209.

[6] Hara K, Yamamoto C, Mills S, et al., 2024, Influence of Certified Perioperative Nurses on the Establishment of Preoperative Outpatient Clinic and Rate of Preoperative Assessment in Japan. Scientific Reports, 14(1): 7.

[7] Moura C, Da M, 2024, Electronic Health Records Kept by Nurses in Perioperative Care. Referencia, 2024(3): 299–314.

[8] Dac M, Toprak A, 2025, Bone Cement Preparation Methods and Safety Precautions for Perioperative Nurses. Orthopaedic Nursing, 44(6): 344–350.

[9] Suto S, Nakayama T, 2025, Development of a Learning Needs Assessment Tool for Perioperative Nurses: A Methodological Study. Nurse Education Today, 148: 106621.

[10] Fajardo E, Tuazon R, Bongco A, 2025, Lived Experiences of Nurses in Delivering Peri-Operative Care. Psychology & Education: A Multidisciplinary Journal, 38(8): 861–877.

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Prevalence and Influencing Factors of Fatigue in Patients with Inflammatory Bowel Disease: A Cross-Sectional Study

Huiqin Zhong [1]†, Xiaojun Wang[2]†, Ya Shao[3]*

[1]Nursing Department, TaiHe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China
[2]Department of Gastroenterology, TaiHe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China
[3]Health Management Center, Wudangshan Campus, TaiHe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China
† These authors contributed equally to this work and share the first authorship.

Author to whom correspondence should be addressed.

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Abstract: *Objective*: To investigate the prevalence of fatigue and identify its associated influencing factors in patients with inflammatory bowel disease (IBD), thereby providing an evidence base for targeted clinical interventions. *Methods*: A cross-sectional survey design was adopted. A total of 204 patients with confirmed IBD diagnoses were consecutively enrolled from the gastroenterology outpatient clinics and inpatient wards of a tertiary-level hospital in Shiyan, Hubei Province, China, between June 2023 and June 2024. Fatigue was assessed using the IBD-Fatigue (IBD-F) scale. Sociodemographic characteristics, disease-related parameters, inflammatory biomarkers, and psychological status were simultaneously collected. Univariable analyses and multivariable logistic regression were performed to identify independent determinants of fatigue. *Results*: Among the 204 enrolled IBD patients, 142 (69.61%) had fatigue (IBD-F ≥ 13). Univariable analyses revealed that sex, disease activity status, anemia, C-reactive protein (CRP) level, serum albumin level, sleep quality, anxiety, and depression were significantly associated with fatigue occurrence (all $p < 0.05$). Multivariable logistic regression identified active disease phase (OR = 3.12, 95% CI: 1.54–6.31, $p = 0.002$), comorbid anemia (OR = 2.87, 95% CI: 1.42–5.80, $p = 0.004$), elevated CRP (OR = 2.43, 95% CI: 1.21–4.88, $p = 0.013$), poor sleep quality (OR = 2.19, 95% CI: 1.10–4.36, $p = 0.026$), and comorbid depression (OR = 3.56, 95% CI: 1.76–7.19, $p = 0.001$) as independent risk factors for fatigue; serum albumin ≥ 35 g/L was identified as a protective factor (OR = 0.48, 95% CI: 0.24–0.96, $p = 0.037$). Fatigue was significantly and negatively correlated with health-related quality of life ($r = -0.61$, $p < 0.001$). *Conclusion*: The prevalence of fatigue in IBD patients is as high as 69.61%, and it is independently associated with disease activity, elevated inflammatory markers, anemia, sleep disturbance, and depression, significantly impairing patients' quality of life. Routine fatigue screening and comprehensive multidimensional management strategies should be integrated into standard IBD care.

Keywords: Inflammatory bowel disease; Fatigue; Influencing factors; Cross-sectional study

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1. Introduction

Inflammatory bowel disease (IBD), encompassing Crohn's disease (CD) and ulcerative colitis (UC), is a chronic, systemic inflammatory disorder of the gastrointestinal tract characterized by relapsing and remitting intestinal inflammation. In recent decades, the global incidence and prevalence of IBD have risen substantially, posing a considerable burden on patients, healthcare systems, and society [1]. Fatigue is among the most commonly reported symptoms in IBD patients, with a reported prevalence of 47–72% [2]. Notably, 40–50% of patients in clinical remission continue to experience clinically significant fatigue, severely impairing their capacity for work, education, and daily functioning [2].

Despite its high burden, fatigue has historically received insufficient clinical attention in the context of IBD, often being dismissed as a secondary manifestation of disease activity. However, fatigue in IBD patients should be regarded as an independent symptom that may persist even during clinical remission, with a multifactorial and complex pathophysiology spanning multiple organ systems [3]. International research has demonstrated that the association between fatigue and disease activity is not absolute; rather, lifestyle factors, psychological status, sleep quality, and numerous other variables may all contribute to fatigue [4]. Epidemiological data on IBD-related fatigue in China remain sparse, and systematic investigations are insufficient.

The IBD-Fatigue (IBD-F) scale, developed by Czuber-Dochan et al., demonstrates high reliability and validity and has been validated and applied across multiple countries [5–9]. However, its application in Chinese IBD populations has been limited. Therefore, this study employed the IBD-F scale to systematically investigate the prevalence and influencing factors of fatigue in IBD patients, with the aim of providing an evidence base for clinically targeted interventions.

2. Methods

2.1. Study design and participants

A convenience sampling approach was used to enroll IBD patients attending the gastroenterology inpatient ward and outpatient clinic of a tertiary-level hospital in Shiyan City, Hubei Province, China, from June 2023 to June 2024.

2.1.1. Inclusion criteria

(1) Diagnosis of IBD in accordance with the 2018 Chinese Society of Gastroenterology consensus guidelines [1];
(2) Age ≥ 18 years;
(3) Confirmed diagnosis for ≥ 3 months;
(4) Intact consciousness with normal reading and comprehension ability; and
(5) Provision of written informed consent and voluntary participation.

2.1.2. Exclusion criteria

(1) Concurrent gastrointestinal malignancy or other malignant tumors;
(2) Coexistence of other major diseases known to cause fatigue (e.g., hypothyroidism, chronic renal failure, congestive heart failure);
(3) Currently undergoing chemotherapy or radiotherapy;

(4) Pregnancy or lactation;
(5) History of blood transfusion within the preceding month; and
(6) Incomplete questionnaire completion.

2.2. Instruments

(1) General information questionnaire

A researcher-designed questionnaire collected sociodemographic data, including sex, age, marital status, education level, occupational status, monthly household income, and type of health insurance.

(2) Disease-related data

Information collected included IBD subtype (CD/UC), disease duration, disease activity status, medication use (corticosteroids, immunosuppressants, and biologics), surgical history, and laboratory parameters (hemoglobin, serum albumin, CRP). Disease activity was assessed using the Harvey-Bradshaw Index (HBI) for CD and the Mayo Score for UC; scores ≥ 5 (CD) or ≥ 3 (UC) were classified as active disease.

(3) IBD-fatigue (IBD-F) scale

The IBD-F was developed in the United Kingdom by Czuber-Dochan et al. [5] in 2014, based on semi-structured interviews with IBD patients, and is specifically designed to assess fatigue in this population. The validated Chinese version, translated by Wang Qian et al., comprises three parts: Part 1 (5 items) and Part 2 (30 items) are scored on a 0–4 Likert scale, with higher scores indicating greater fatigue and greater impact on daily activities; Part 3 consists of 5 open-ended questions and is not included in scoring. A Part 1 total score ≥ 13 was used to define the presence of fatigue; scores of 13–19, 20–29, and ≥ 30 were classified as mild, moderate, and severe fatigue, respectively. The Chinese version demonstrates excellent psychometric properties, with a Cronbach's α of 0.966 and a test-retest reliability coefficient of 0.850 [10].

(4) Pittsburgh sleep quality index (PSQI)

The PSQI comprises 19 self-reported items with a total score range of 0–21; a score > 7 indicates poor sleep quality. The scale has been widely validated in Chinese populations and demonstrates good reliability and validity [11].

(5) Patient health questionnaire-9 (PHQ-9)

The PHQ-9 consists of 9 items with a total score range of 0–27; a score ≥ 10 indicates clinically significant depression. The PHQ-9 has been validated in IBD populations with favorable psychometric properties [12].

(6) Generalized anxiety disorder-7 (GAD-7)

The GAD-7 consists of 7 items with a total score range of 0–21; a score ≥ 10 indicates clinically significant anxiety. It demonstrates good reliability and validity in IBD patients [12].

2.3. Data collection

Data were collected by trained researchers using a combination of face-to-face interviews and self-administered questionnaires. Hospitalized patients were surveyed at least 48 hours after admission; outpatients were surveyed at the time of their clinic visit. Questionnaires were distributed and retrieved on-site. Where necessary, researchers provided item-by-item clarification without guiding responses. A total of 220 questionnaires were distributed, and 204 valid questionnaires were returned, yielding an effective

response rate of 92.73%. Laboratory parameters, including CRP, ESR, hemoglobin, albumin, and fecal calprotectin, were extracted from patients' medical records.

2.4. Statistical analysis

All data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables conforming to normal distribution were expressed as mean ± standard deviation (SD) and compared between groups using independent-samples *t*-tests. Categorical variables were expressed as frequencies and percentages (%) and compared using chi-squared (χ^2) tests or Fisher's exact test as appropriate. Variables with $p < 0.05$ in univariable analyses were entered into multivariable logistic regression using a stepwise backward elimination method. The presence or absence of fatigue served as the dependent variable (fatigue = 1, no fatigue = 0); odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated. Statistical significance was set at $p < 0.05$.

3. Results

3.1. Participant characteristics

A total of 204 IBD patients were enrolled. The sample comprised 98 males (48.04%) and 106 females (51.96%), with ages ranging from 18 to 72 years (mean ± SD: 38.42 ± 12.16 years). CD was diagnosed in 123 patients (60.29%) and UC in 81 patients (39.71%). Disease duration ranged from 1 to 22 years (mean ± SD: 5.84 ± 4.37 years). Sixty-four patients (31.37%) had active disease, and 140 (68.63%) were in remission. Seventy-nine patients (38.73%) had concurrent anemia; 71 (34.80%) had elevated CRP (> 8 mg/L); 58 (28.43%) had serum albumin < 35 g/L; 96 (47.06%) had poor sleep quality (PSQI > 7); 81 (39.71%) had comorbid depression (PHQ-9 ≥ 10); and 74 (36.27%) had comorbid anxiety (GAD-7 ≥ 10).

3.2. Prevalence and severity of fatigue

The mean IBD-F total score for all 204 patients was 18.37 ± 8.24. One hundred and forty-two patients (69.61%) had IBD-F scores ≥ 13 and were classified as fatigued. Among the 142 fatigued patients, 68 (47.89%) had mild fatigue (IBD-F 13–19), 51 (35.92%) had moderate fatigue (IBD-F 20–29), and 23 (16.20%) had severe fatigue (IBD-F ≥ 30). Thus, moderate-to-severe fatigue (IBD-F ≥ 20) was present in 74 patients, representing 52.11% of the fatigued cohort.

The mean IBD-F score in the fatigue group was 23.81 ± 7.43, compared with 8.16 ± 3.29 in the non-fatigue group ($t = 14.27$, $p < 0.001$). Fatigue prevalence was 72.36% (89/123) in CD patients and 65.43% (53/81) in UC patients; the difference between subtypes was not statistically significant ($\chi^2 = 1.24$, $p = 0.265$). Fatigue was significantly and negatively correlated with health-related quality of life ($r = -0.61$, $p < 0.001$).

3.3. Univariable analysis of factors associated with fatigue

Univariable analyses were performed with fatigue status (IBD-F ≥ 13) as the dependent variable. Results are presented in **Table 1**. Sex ($\chi^2 = 4.38$, $p = 0.036$), disease activity ($\chi^2 = 18.76$, $p < 0.001$), anemia ($\chi^2 = 16.43$, $p < 0.001$), elevated CRP ($\chi^2 = 12.87$, $p < 0.001$), serum albumin level ($\chi^2 = 9.54$, $p = 0.002$), poor sleep quality ($\chi^2 = 21.34$, $p < 0.001$), depression ($\chi^2 = 26.82$, $p < 0.001$), and anxiety ($\chi^2 = 14.56$, $p < 0.001$) were all significantly associated with fatigue (all $p < 0.05$). Age, IBD subtype, disease duration, corticosteroid use, biologic agent use, education level, and surgical history showed no statistically significant association with

fatigue (all $p > 0.05$).

Table 1. Univariable analysis of factors associated with fatigue in IBD patients (n = 204)

Variable	Fatigue group (n = 142), n (%)	Non-fatigue group (n = 62), n (%)	t/χ^2	*p*
Sex			4.38	0.036
Female (n = 106)	82 (77.36)	24 (22.64)		
Male (n = 98)	60 (61.22)	38 (38.78)		
Age (years, mean ± SD)	39.14 ± 12.53	36.89 ± 11.24	1.12	0.264
Education level			1.87	0.393
Middle school or below (n = 48)	35 (72.92)	13 (27.08)		
High school/vocational (n = 71)	51 (71.83)	20 (28.17)		
College or above (n = 85)	56 (65.88)	29 (34.12)		
IBD subtype: CD (n = 123)	89 (72.36)	34 (27.64)	1.24	0.265
Disease duration (years, mean ± SD)	6.12 ± 4.51	5.23 ± 4.05	1.24	0.218
Active disease phase (n = 64)	57 (89.06)	7 (10.94)	18.76	< 0.001
Surgical history (n = 37)	30 (81.08)	7 (18.92)	2.06	0.151
Anemia (n = 79)	67 (84.81)	12 (15.19)	16.43	< 0.001
Elevated CRP (n = 71)	60 (84.51)	11 (15.49)	12.87	< 0.001
Serum albumin < 35 g/L (n = 58)	49 (84.48)	9 (15.52)	9.54	0.002
Corticosteroid use (n = 52)	40 (76.92)	12 (23.08)	2.18	0.140
Biologic agent use (n = 46)	30 (65.22)	16 (34.78)	1.03	0.310
Poor sleep quality (PSQI > 7, n = 96)	82 (85.42)	14 (14.58)	21.34	< 0.001
Depression (PHQ-9 ≥ 10, n = 81)	70 (86.42)	11 (13.58)	26.82	< 0.001
Anxiety (GAD-7 ≥ 10, n = 74)	62 (83.78)	12 (16.22)	14.56	< 0.001

3.4. Multivariable logistic regression analysis of factors associated with fatigue

Fatigue status served as the dependent variable (fatigue = 1, no fatigue = 0). The eight variables achieving $p < 0.05$ in univariable analysis, including sex, disease activity, anemia, elevated CRP, serum albumin level, poor sleep quality, depression, and anxiety, were entered as independent variables into multivariable logistic regression using a stepwise backward elimination method. Variable coding is presented in **Table 2**, and regression results are shown in **Table 3**.

Table 2. Variable coding for multivariable logistic regression analysis

Variable	Coding
Fatigue (dependent variable)	Present = 1, Absent = 0
Sex	Female = 1, Male = 0
Disease activity	Active phase = 1, Remission = 0
Anemia	Present = 1, Absent = 0
Elevated CRP (> 8 mg/L)	Yes = 1, No = 0
Serum albumin	< 35 g/L = 1, ≥ 35 g/L = 0
Sleep quality	Poor (PSQI > 7) = 1, Good (PSQI ≤ 7) = 0
Depression	Present (PHQ-9 ≥ 10) = 1, Absent = 0
Anxiety	Present (GAD-7 ≥ 10) = 1, Absent = 0

Table 3. Multivariable logistic regression analysis of factors associated with fatigue in IBD patients

Variable	β	SE	Wald χ^2	*p*	OR	95% CI
Active disease phase	1.14	0.36	10.03	0.002	3.12	1.54–6.31
Anemia	1.05	0.36	8.51	0.004	2.87	1.42–5.80
Elevated CRP	0.89	0.36	6.12	0.013	2.43	1.21–4.88
Poor sleep quality	0.78	0.35	4.96	0.026	2.19	1.10–4.36
Depression	1.27	0.36	12.43	0.001	3.56	1.76–7.19
Serum albumin ≥ 35 g/L	-0.73	0.35	4.35	0.037	0.48	0.24–0.96
Constant	-1.32	0.42	9.88	0.002	—	—

Multivariable logistic regression identified active disease phase (OR = 3.12, 95% CI: 1.54–6.31, $p = 0.002$), comorbid anemia (OR = 2.87, 95% CI: 1.42–5.80, $p = 0.004$), elevated CRP (OR = 2.43, 95% CI: 1.21–4.88, $p = 0.013$), poor sleep quality (OR = 2.19, 95% CI: 1.10–4.36, $p = 0.026$), and comorbid depression (OR = 3.56, 95% CI: 1.76–7.19, $p = 0.001$) as independent risk factors for fatigue in IBD patients. Serum albumin ≥ 35 g/L was identified as a protective factor against fatigue (OR = 0.48, 95% CI: 0.24–0.96, $p = 0.037$).

4. Discussion

4.1. High prevalence of fatigue in IBD patients

The present study found a fatigue prevalence of 69.61% among 204 IBD patients, which exceeds the overall fatigue rates of 26.4%–54% reported in the systematic review by Radford et al. [4]. This discrepancy may be attributed to the higher proportion of patients with active disease in our sample (31.37%) and the fact that patients were recruited exclusively from tertiary-level medical centers, where disease severity tends to be greater. In comparison with domestic literature, our findings are slightly lower than the 89.6% fatigue rate in Chinese IBD patients reported by Wang et al. [13]. Notably, moderate-to-severe fatigue (IBD-F ≥ 20) was present in 74 patients (52.11% of the fatigued cohort), indicating that a substantial proportion of IBD patients bear a significant fatigue burden, consistent with the assertion by Czuber-Dochan et al. that fatigue is among the most distressing symptoms experienced by IBD patients [5].

4.2. Disease activity as the primary determinant of fatigue

In the present study, the fatigue prevalence among patients with active disease was 89.06% (57/64), significantly higher than the 60.71% (85/140) observed in patients in remission; active disease was confirmed as an independent risk factor for fatigue (OR = 3.12). During active disease, intestinal inflammation drives the excessive release of pro-inflammatory cytokines (including TNF-α, IL-6, and IL-1β), which traverse the blood-brain barrier to act on the central nervous system, inducing “sickness behavior” manifested as fatigue, somnolence, and cognitive impairment [14]. Remarkably, 60.71% of patients in clinical remission still experienced fatigue, higher than the 41–48% remission-phase fatigue rate reported by Czuber-Dochan et al. [15]. This suggests that IBD-related fatigue operates through mechanisms independent of disease activity, potentially involving intestinal dysbiosis and gut-brain axis dysfunction [14], warranting further investigation.

4.3. Anemia and inflammatory biomarkers as key biological determinants

Both comorbid anemia (OR = 2.87) and elevated CRP (OR = 2.43) were identified as independent risk factors for fatigue, consistent with international research findings [16]. The prevalence of anemia in our IBD

cohort was 38.73%, attributable primarily to impaired iron absorption, hepcidin elevation driven by chronic inflammation, and gastrointestinal blood loss, resulting in insufficient oxygen delivery to tissues and a direct contribution to fatigue [14]. As a systemic inflammatory marker, elevated CRP reflects a state of persistent inflammation that affects the central nervous system through cytokine-mediated pathways. Conversely, serum albumin ≥ 35 g/L was identified as a protective factor (OR = 0.48), suggesting that adequate nutritional status contributes to reduced fatigue burden, a finding consistent with the conclusions of Tasson et al. [17].

4.4. Depression as the strongest psychological determinant

Multivariable analysis identified depression as the single most potent independent risk factor for fatigue in IBD patients (OR = 3.56), surpassing all other variables in magnitude. This is highly concordant with the findings of Emerson et al. in a cohort of 834 IBD patients, in which 59.8% of patients had comorbid depression closely associated with fatigue [18]. The relationship between fatigue and depression is bidirectional: depression exacerbates fatigue by disrupting sleep, reducing motivation for physical activity, and promoting neuroinflammation; conversely, persistent fatigue may precipitate or intensify depressive symptoms [19]. Notably, anxiety was statistically significant in univariable analysis ($\chi^2 = 14.56$, $p < 0.001$) but was eliminated in the multivariable model, suggesting that the effect of anxiety on fatigue may be partially mediated through depression.

4.5. Independent effect of sleep quality on fatigue

The prevalence of poor sleep quality (PSQI > 7) in this study was 47.06% (96/204), substantially higher than that observed in the general population, and poor sleep quality was confirmed as an independent risk factor for fatigue (OR = 2.19). Sleep disturbance in IBD patients typically arises from a combination of abdominal pain, nocturnal defecation, corticosteroid therapy, and comorbid anxiety and depression, with poor sleep quality further exacerbating fatigue in a vicious cycle. These findings suggest that sleep-targeted interventions, including sleep hygiene education and cognitive behavioral therapy for insomnia (CBT-I), should be incorporated into comprehensive fatigue management programs for IBD patients.

4.6. Limitations

This study has several limitations. First, convenience sampling from a single tertiary-level center may introduce selection bias and limit the generalizability of findings to the broader IBD population. Second, the cross-sectional design precludes causal inference; in particular, the temporal and bidirectional relationship between fatigue and depression requires confirmation through longitudinal studies. Third, certain nutritional parameters potentially relevant to fatigue, such as vitamin D levels and serum ferritin, were not collected.

5. Conclusion

The prevalence of fatigue in IBD patients is as high as 69.61%, with moderate-to-severe fatigue accounting for more than half of affected individuals; fatigue is significantly and negatively associated with health-related quality of life. Active disease phase, anemia, elevated CRP, poor sleep quality, and depression are independent risk factors for fatigue, while normal serum albumin (≥ 35 g/L) serves as a protective factor. Clinicians and nursing staff should incorporate routine fatigue screening into standard IBD management, with particular attention to patients in the active disease phase and those with comorbid anemia or psychological

disorders. Multidimensional, integrated intervention strategies focusing on inflammation control, anemia correction, sleep improvement, and psychological support should be implemented to alleviate the fatigue burden and improve quality of life in this patient population.

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References

[1] Chinese Society of Gastroenterology, IBD Group, 2018, Consensus on the Diagnosis and Treatment of Inflammatory Bowel Disease (2018, Beijing). Chin J Gastroenterol, 38(5): 292–311.

[2] Czuber-Dochan W, Ream E, Norton C, 2013, Review Article: Description and Management of Fatigue in Inflammatory Bowel Disease. Aliment Pharmacol Ther, 37: 505–516.

[3] Abdulla M, Mohammed N, AlQamish J, et al., 2025, Quality of Life and Fatigue in Inflammatory Bowel Disease: A Systematic Review. Healthcare, 13: 2203.

[4] Radford S, McGing J, Czuber-Dochan W, et al., 2021, Systematic Review: The Impact of Inflammatory Bowel Disease-Related Fatigue on Health-Related Quality of Life. Frontline Gastroenterol, 12: 11–21.

[5] Czuber-Dochan W, Norton C, Bassett P, et al., 2014, Development and Psychometric Testing of Inflammatory Bowel Disease Fatigue (IBD-F) Patient Self-Assessment Scale. J Crohns Colitis, 8: 1398–1406.

[6] Hatamnejad M, Shirvani M, Pourhoseingholi A, et al., 2023, Translation and Cross-Cultural Adaptation of the Persian Version of Inflammatory Bowel Disease-Fatigue (IBD-F) Self-Assessment Questionnaire. PLOS ONE, 18: e0288592.

[7] Liebert A, Wileńska A, Czuber-Dochan W, et al., 2021, Translation and Validation of the Inflammatory Bowel Disease Fatigue (IBD-F) Patient Self-Assessment Questionnaire. Gastroenterol Rev, 16: 136–143.

[8] Stoker A, Gruters A, Loon M, et al., 2023, Translation, Validation and Psychometric Properties of the Dutch Version of the Inflammatory Bowel Disease-Fatigue (IBD-F) Self-Assessment Scale. J Patient-Rep Outcomes, 7: 108.

[9] Scholz K, Thomann A, Teich N, et al., 2023, Validation of the German Inflammatory Bowel Disease Fatigue (IBD-F) Questionnaire. Z Für Gastroenterol, 61: 164–171.

[10] Wang Q, Wan Q, 2022, Translation and Reliability/Validity Testing of the Chinese Version of the Inflammatory Bowel Disease Fatigue Self-Assessment Scale. Chin J Nurs Educ, 19(2): 166–171.

[11] Liu X, Tang M, Hu L, et al., 1996, Reliability and Validity of the Pittsburgh Sleep Quality Index. Chin J Psychiatry, 1996(2): 103–107.

[12] Mikocka-Walus A, Knowles S, Keefer L, et al., 2016, Controversies Revisited: A Systematic Review of the Comorbidity of Depression and Anxiety with Inflammatory Bowel Diseases. Inflamm Bowel Dis, 22: 752–762.

[13] Wang Q, Li J, Ding X, et al., 2024, Fatigue Status and Path Analysis of Influencing Factors in Patients with Inflammatory Bowel Disease. Chin Nurs Manag, 24(5): 663–668.

[14] Truyens M, Lernout H, De Vos M, et al., 2024, Unraveling the Fatigue Puzzle: Insights into the Pathogenesis and Management of IBD-Related Fatigue Including the Role of the Gut-Brain Axis. Front Med, 11: 1424926.

[15] Czuber-Dochan W, Dibley L, Terry H, et al., 2013, The Experience of Fatigue in People with Inflammatory Bowel Disease: An Exploratory Study. J Adv Nurs, 69: 1987–1999.

[16] Bergamaschi G, Castiglione F, D'Incà R, et al., 2023, Prevalence, Pathogenesis and Management of Anemia in Inflammatory Bowel Disease: An IG-IBD Multicenter, Prospective, and Observational Study. Inflamm Bowel Dis, 29: 76–84.

[17] Tasson L, Zingone F, Barberio B, et al., 2021, Sarcopenia, Severe Anxiety and Increased C-Reactive Protein Are Associated with Severe Fatigue in Patients with Inflammatory Bowel Diseases. Sci Rep, 11: 15251.

[18] Emerson C, Skvarc D, Mikocka-Walus A, et al., 2024, People with Inflammatory Bowel Disease Prefer Cognitive Behavioral Therapy for Fatigue Management: A Conjoint Analysis. Dig Dis Sci, 69: 2345–2353.

[19] Barnes A, Bryant R, Mukherjee S, et al., 2024, Depression Influences Fatigue in Inflammatory Bowel Disease Amongst Other Factors: A Structural Modeling Approach. Ther Adv Gastroenterol, 17: 17562848241271987.

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Research on Flipped Classroom Teaching Mode Combining Evidence-based Medicine with Case Teaching

Huiping Liu, Xinru Li, Libo Zhou*, Miao Liu, Minghui Chu

School of Stomatology, Jiamusi University, Jiamusi 154007, Heilongjiang, China

Author to whom correspondence should be addressed.

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Abstract: *Objective*: This research aims to explore the pedagogical impact of the flipped classroom methodology informed by Evidence - Based Medicine (EBM) and Case-Based Learning (CBL) on the clinical education of students specializing in oral mucosal diseases. The primary goal is to improve the overall clinical practical skills of dental students. *Methods*: A total of 184 interns from the Department of Periodontal Mucosal Diseases at the Stomatology College of Jiamusi University, who were enrolled in a five-year undergraduate program in oral medicine from May 2020 to September 2022, participated in the study. The interns were randomly assigned to either the control group, which received traditional teaching methods, or the experimental group, which experienced a flipped classroom model based on Evidence - Based Medicine (EBM) and Case - Based Learning (CBL). The effectiveness of the teaching methods was assessed at the end of the internship through theoretical examinations and questionnaire surveys, among other evaluation techniques. *Results*: The findings of the evaluation of teaching quality, the theoretical knowledge, clinical practice skills, and case analysis scores of the experimental group were 86.18 ± 6.62, 86.53 ± 6.86, and 87.10 ± 6.82, respectively. These values were significantly higher than those of the control group (79.71 ± 7.95, 72.52 ± 9.26, and 71.91 ± 9.04); students' overall quality and course satisfaction were statistically significant ($p < 0.05$) when compared to the control group. *Conclusion*: The flipped classroom teaching model based on Evidence-Based Medicine (EBM) and Case - Based Learning (CBL) effectively leverages the strengths of both methodologies. This combination not only improves traditional teaching methods, ignites students' enthusiasm for learning, and fosters innovative thinking, but also contributes positively to enhancing clinical practical skills. Overall, this educational approach significantly benefits the clinical training of periodontal mucosal diseases, increasing teaching effectiveness and satisfaction for both educators and students.

Keywords: Evidence-based medicine; Reform in education; The flipped classroom; Stomatology; Oral mucosal disease; Clinical logical thinking ability

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1. Introduction

Oral Mucosal Disease is a discipline-oriented practical curriculum that places stringent requirements on stomatology undergraduates' comprehensive quality and clinical research capacity. The clinical internship phase during undergraduate education serves as a critical transitional period from classroom learning to formal clinical practice, where the cultivation of students' critical thinking should be prioritized [1,2]. In conventional internship training dominated by teacher-centered demonstration and knowledge indoctrination, students learn passively, resulting in incomplete knowledge absorption and rigid mindset formation [3,4]. Against the backdrop of the "Internet Plus" initiative, the flipped classroom has gradually been introduced into medical education, enabling extracurricular autonomous learning and educational resource integration. Evidence-Based Medicine (EBM) integrates clinical data with exploratory thinking on the basis of scientific research to facilitate updated medical knowledge and standardized clinical diagnostic thinking [5,6]. Combined with the disciplinary features of Oral Mucosal Diseases, this study constructs an integrated flipped classroom teaching system incorporating EBM and Case-Based Learning (CBL), and evaluates its teaching efficacy to improve undergraduates' innovative capacity and comprehensive competency in stomatology.

2. Materials and methods

2.1. General information

A total of 184 five year program stomatology undergraduates undergoing clinical rotation at the Department of Periodontal and Mucosal Diseases, Affiliated Stomatological Hospital of Jiamusi University between July 2020 and July 2022 were enrolled; all participants fully understood the research content and volunteered for this study. Participants were randomly divided into a control group and an experimental group, ensuring equal representation in both. The control group comprised 38 males and 54 females aged 19 to 27 years, with an average age of (22.52 ± 3.53) years. In contrast, the experimental group consisted of 34 males and 58 females aged 19 to 28 years, averaging (22.54 ± 6.36) years old. Baseline data showed no statistically significant inter-group difference ($p > 0.05$), assuring comparability between cohorts. All participants provided informed consent, except for those who withdrew partway through the process. All teaching sessions for both groups were delivered by one experienced instructor proficient in clinical practice and pedagogy.

2.2. Teaching protocols

2.2.1. Control group

Teaching was based on the 5th edition of Oral Mucosal Diseases, published by People's Medical Publishing House, with multimedia-assisted instruction for each 45-minute class. Conventional teaching modes, including thematic lectures and typical case discussions, were adopted.

2.2.2. Experimental group

The flipped classroom guided by EBM principles combined with CBL was implemented within 45-minute teaching sessions following five specific procedures:

(1) In accordance with the 2019 Jiamusi University teaching syllabus, typical clinical cases such as oral lichen planus and recurrent aphthous ulcer were selected to elaborate clinical manifestations, predisposing factors, diagnostic criteria, differential diagnosis, therapeutic principles, and individualized regimens.

(2) Students retrieved and reviewed relevant literature to obtain authoritative clinical evidence for solving clinical puzzles and standardizing diagnostic and therapeutic protocols.
(3) Retrieved clinical evidence was screened and graded based on the evidence hierarchy to verify reliability and clinical operability.
(4) Supervising tutors guided in-depth case discussion during clinical practice, summarized disputed issues, and translated research conclusions into individualized patient treatment plans.
(5) Instructors guided students to collect all available clinical trial data throughout the curriculum and conduct a systematic assessment of relevant research outcomes.

2.3. Observation indicators

Three senior stomatology teachers with abundant clinical and teaching experience were assigned to evaluate teaching outcomes from four dimensions: written examinations, clinical skill assessment, curriculum satisfaction questionnaire, and comprehensive competency evaluation. All questionnaires were completed anonymously. Written tests mimicked the format of a national licensed physician written examination with a full score of 100; clinical operation and case analysis adopted a three-station interview mode identical to a licensed physician practical assessment with blind marking (full score:100 for each item). In the satisfaction survey, a score of 10 points indicates satisfaction, 8 to 9 points signifies basic satisfaction, and 4 to 5 points reflects dissatisfaction. Respondents who scored 6 points or higher were considered satisfied. In a comprehensive competency assessment, each indicator was scored 1–10 anonymously by students themselves, with higher scores standing for stronger corresponding abilities.

2.4. Statistical analysis

The SPSS 26 .0 program was used for all statistical analyses. Listing data were given as (n, %) and examined using the Chi-square test; measurement data were shown as mean, standard deviation, and compared using an independent sample *t*-test. $p < 0.05$ showed a statistically significant difference.

3. Results

3.1. Comparison of academic scores between two groups

Statistically higher scores in theoretical knowledge, clinical operational skills, and case analysis were observed in the experimental group versus the control group ($p < 0.05$), as detailed in **Table 1**.

Table 1. Comparison of teaching assessment scores between the two groups (Mean ± SD, n = 92)

Group	Theoretical knowledge	Clinical practical	Skills case analysis
Experimental group	86.18 ± 6.62	86.53 ± 6.86	87.10 ± 6.82
Control group	79.71 ± 7.95	72.52 ± 9.26	71.91 ± 9.04
t value	5.992	11.667	12.863
p value	**< 0.05**	< 0.05	< 0.05

3.2. Curriculum satisfaction survey

The experimental group demonstrated significantly greater overall satisfaction with the curriculum ($p < 0.05$).

Two students from the experimental group expressed dissatisfaction due to the excessive time cost of the new teaching mode, while 11 students in the control group were unsatisfied with the monotonous curriculum design and insufficient hands-on clinical opportunities, leading to low learning motivation (**Table 2**).

Table 2. Curriculum satisfaction comparison between two groups [n = 92, n (%)]

Group	n	Satisfied	Basically satisfied	Dissatisfied	Total satisfaction rate
Experimental group	92	80 (86.96)	10 (10.87)	2 (2.17)	90 (97.82)
Control group	92	49 (53.26)	32 (34.78)	11 (11.96)	81 (88.04)
χ^2					25.204
p					< 0.05

3.3. Comprehensive competency assessment

All comprehensive competency indicators of the experimental group outperformed those of the control group with statistical significance ($p < 0.05$), as shown in **Table 3**.

Table 3. Student comprehensive competency scores (Mean ± SD, n = 92)

Group	Learning interest & efficiency	Learning initiative	Communi cation ability	Teamwork capacity	Analytical	Skill problem-solving	Skill literature retrieval	Skill clinical thinking ability
Experimental group	8.79 ± 0.70	9.05 ± 0.54	8.72 ± 0.61	9.09 ± 0.63	18.06 ± 0.99	17.44 ± 0.95	16.57 ± 1.16	17.70 ± 0.64
Group control	8.01 ± 0.73	8.16 ± 0.77	8.22 ± 0.68	8.27 ± 0.65	15.21 ± 1.39	14.28 ± 1.54	13.12 ± 1.81	13.28 ± 1.45
t value	7.391	9.074	5.250	8.682	16.023	16.757	15.393	26.745
p value	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

4. Discussion

4.1. Limitations of traditional teaching methods

The report presented to the 20th National Congress of the Communist Party of China highlights a people-centered approach to educational development, the establishment of a high-quality education system, and the promotion of quality-oriented education [7–9]. It also focuses on the growth of foundational, emerging, and interdisciplinary fields, providing essential guidelines for curriculum - based ideological and political education across various aspects, including curriculum development, practical education, and the digitalization of ideological education [10]. Faculty development and the expansion of the educational framework. These elements collectively outline key objectives for the ongoing educational reform. Accelerated globalization of medical education and national science and technology revitalization strategy raise higher requirements for innovative medical talent cultivation and undergraduates' practical capabilities, making cultivation of high-quality interdisciplinary professionals a core mission for modern higher education in line with social development demands [11,12]. While solid theoretical grounding is essential for stomatology undergraduates, translating textbook knowledge into individualized clinical diagnosis and treatment remains a prominent challenge for graduating students. Traditional teacher-centric teaching has obvious limitations in practical training: it prioritizes knowledge indoctrination over on-site clinical observation, restricts

teacher–student interaction, deprives students of direct participation in clinical management, and dampens autonomous learning enthusiasm [13,14]. Most medical undergraduates complete four years of classroom theoretical learning before a one-year clinical internship, highlighting the vital role of clinical rotation in fostering self-directed learning and a smooth transition from student to clinician. Recent educational reforms advocate shifting from lecture-based passive teaching toward student-centered pedagogy featuring high-order thinking and active classroom engagement.

4.2. Application effect of EBM-CBL integrated flipped classroom in oral mucosal disease internship education

Medicine features strong professionalism and practicality alongside an evolving disease spectrum, continuously posing new challenges for clinical practitioners and raising competency benchmarks for medical graduates. Qualified clinicians require a robust theoretical foundation, evidence-based thinking, and basic research literacy. Rooted in authentic clinical scenarios, EBM guides personalized diagnosis and treatment by combining authoritative clinical evidence with individual patient conditions [15]. EBM training cultivates a standardized clinical decision-making mindset for students and requires instructors to master comprehensive basic medical disciplines, including anatomy, physiology, pharmacology, and pathology; meanwhile, learners shift from in-class passive listening to pre-class autonomous preview and interactive in-class discussion focused on clinical thinking development. Sharing an identical educational philosophy focused on inquiry-driven clinical problem-solving, CBL links textbook knowledge with real-world clinical practice to sharpen trainees' clinical reasoning and emergency management capacity.

Originating from self-regulated learning and constructivist learning theories [16,17]. The flipped classroom rearranges in-class and extracurricular learning time to transfer learning dominance from instructors to learners via pre-class independent knowledge acquisition and in-class collaborative discussion and knowledge application instead of cramming education. The combined EBM-CBL flipped classroom introduced in stomatology internship integrates respective pedagogical merits to shift education from passive knowledge infusion toward active problem -solving, effectively boosting independent learning, teamwork, and innovative clinical reasoning [18]. However, this teaching approach cannot be universally applied to all subject matter; future reforms should involve the development of tailored teaching strategies based on the learner's stage and the curriculum content. This will aid students in cultivating critical thinking through independent literature research, analytical speculation, and the integration of theory with practice. This study has inherent limitations, including a limited sample size and insufficient long-term follow-up constrained by academic schedule; further optimization of evaluation scales and expanded cohort will be implemented in subsequent research.

5. Conclusion

In conclusion, the integrated EBM and CBL flipped classroom mode significantly enhances undergraduates' learning initiative, comprehensive competency, and curriculum satisfaction, stimulates learning motivation and logical clinical thinking, alleviates clinical adaptation pressure, and facilitates a seamless combination of theoretical knowledge and clinical practice. It improves overall academic performance and achieves favorable teaching outcomes worthy of widespread promotion in clinical stomatology education.

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The authors declare no conflict of interest.

References

[1] Lin G, Tan W, Tan H, et al., 2023, Innovative Pedagogical Strategies in Health Professions Education: Active Learning in Dental Materials Science. Int J Environ Res Public Health, 20(3): 239–243.

[2] Shen J, Yuan L, Ge R, et al., 2022, Improving Medical Student Recruitment into Neurosurgery Through Teaching Reform. BMC Med Educ, 22(1): 656.

[3] Xu X, Wang Y, Zhang S, et al., 2022, Performance of Problem-Based Learning-Based Image Teaching in Clinical Emergency Teaching. Front Genet, 13: 931640.

[4] Blair R, Caton J, Hamnvik O, 2023, A Flipped Classroom in Graduate Medical Education. Clin Teach, 17(2): 195–199.

[5] Chen F, Lui A, Martinelli S, 2022, A Systematic Review of the Effectiveness of Flipped Classrooms in Medical Education. Med Educ, 51(6): 585–597.

[6] Mercuri M, 2024, The Ever-Shifting Source of Authority on What Works in Clinical Medicine. J Eval Clin Pract, 25(5): 703–705.

[7] Qi X, 2023, Advancing Standardized Resident Training Quality under the Guidance of the Spirit of the 20th CPC National Congress—Keynote Report at 2022 National Standardized Resident Training Summit. Chinese Journal of Continuing Medical Education, 7(1): 1–5.

[8] Yu K, Hu D, 2023, Traditional Chinese Medicine and Chinese Civilization: Research Series on "Two Integrations" of the Spirit of the 20th CPC National Congress (IV). Journal of Yulin Normal University, 44(2): 59–67.

[9] Yao G, 2023, Exploration on Chinese Modernization of Education Based on Educational Reform Practices since the 18th CPC National Congress and Relevant Statements from the 20th CPC National Congress. Journal of Inner Mongolia Normal University (Educational Science Edition), 36(3): 1–10.

[10] Gou L, Yao J, Guo H, 2022, Reflections on Evidence-Based Medicine Teaching among Undergraduates at a Medical University in Xinjiang. Xinjiang Medical Journal, 52(8): 992–994.

[11] Tao H, Liang L, 2022, Theoretical and Practical Exploration on Educational Administration of Medical Universities under Green Ecology Concept. Environmental Engineering, 40(10): 256.

[12] Wang J, Zhang R, He M, et al., 2020, Existing Problems and Countermeasures of Higher Education. Vocational Education, 2020(6): 8–9.

[13] Sao Y, Yeh W, Hsu T, et al., 2022, Implementing a Flipped Classroom Model in an Evidence-Based Medicine Curriculum for Pre-Clinical Medical Students: Evaluating Learning Effectiveness Through Prospective Propensity Score-Matched Cohorts. BMC Med Educ, 22(1): 185.

[14] Lu C, Xu J, Cao Y, et al., 2023, Examining the Effects of Student-Centered Flipped Classroom in Physiology Education. BMC Med Educ, 23(1): 233.

[15] Ji C, 2022, Highlight TCM Advantages and Cultivate Modern Evidence-Based Thinking: Reform Practice of Evidence-Based Medicine Teaching. Journal of Traditional Chinese Medicine Management, 30(11): 234–236.

[16] Tang B, Sandarage R, Chai J, et al., 2022, A Systematic Review of Evidence-Based Practices for Clinical Education and Health Care Delivery in the Clinical Teaching Unit. CMAJ, 194(6): E186–E194.

[17] Tee W, Tan S, Marican F, et al., 2022, Comparison of Digital Interactive Case-Based Educational Resource with Virtual Role Play in Dental Undergraduates in Clinical Oral Medicine/Oral Pathology Education. Healthcare (Basel), 10(9): 44567.

[18] Li P, Lan X, Ren L, et al., 2023, Research and Practice of the BOPPPS Teaching Model Based on the OBE Concept in Clinical Basic Laboratory Experiment Teaching. BMC Med Educ, 23(1): 882.

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Study on the Correlation Between Preoperative Anemia and Postoperative Nausea and Vomiting in Patients Undergoing Laparoscopic Cholecystectomy

Xu Hu, Shengping Zheng, Lun Mao, Chaolong Liu, Mingquan Wang*

Department of Anesthesiology, Zizhong County People's Hospital, Neijiang 641200, Sichuan, China

Author to whom correspondence should be addressed.

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Abstract: *Objective:* To investigate the correlation between preoperative anemia and postoperative nausea and vomiting (PONV) in patients undergoing laparoscopic cholecystectomy (LC), and to analyze 14 influencing factors of PONV to provide references for clinical prevention and treatment. *Methods:* A prospective cohort study was conducted, including 400 patients who underwent LC in our hospital from June 2024 to May 2026. Patients were grouped based on the occurrence of postoperative PONV, and the incidence of PONV was compared between anemic and non-anemic patients. Univariate and multivariate logistic regression analyses were used to analyze the influencing factors of PONV. *Results:* In the PONV group, the proportion of anemic patients was higher than that of non-anemic patients, but the difference was not statistically significant ($p = 0.069$). There were statistically significant differences in baseline data, such as gender, history of motion sickness, and postoperative opioid analgesia, between the two groups (all $p < 0.05$). Univariate regression analysis of five potential factors showed that three factors, namely female gender, history of motion sickness, and postoperative opioid analgesia, were significantly associated with PONV (all $p < 0.05$). Multivariate regression analysis revealed that female gender, history of motion sickness, and postoperative opioid analgesia were independent risk factors for PONV after LC ($p < 0.05$). *Conclusion:* Female gender, history of motion sickness, and postoperative opioid analgesia are closely related to PONV and are independent risk factors for PONV in patients undergoing LC, while preoperative anemia is not a risk factor for PONV after LC.

Keywords: Laparoscopic cholecystectomy; Preoperative anemia; Postoperative nausea and vomiting; Risk factors

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1. Introduction

Laparoscopic cholecystectomy (LC) is the preferred minimally invasive surgical procedure for treating benign gallbladder diseases, offering advantages such as minimal trauma and rapid recovery. However,

the incidence of postoperative nausea and vomiting (PONV) remains high [1]. PONV not only increases patient discomfort but may also lead to complications such as wound dehiscence, aspiration, and electrolyte disturbances, prolonging hospital stays and affecting postoperative recovery. Preoperative anemia is a common comorbidity in surgical patients, with an incidence of approximately 30% to 40%. Anemia can lead to inadequate tissue oxygenation, abnormal gastrointestinal mucosal perfusion, and neurotransmitter disturbances, potentially increasing the risk of postoperative complications [2]. Current research on the influencing factors of PONV after LC primarily focuses on gender, smoking history, anesthesia method, and surgical duration, with limited studies directly examining the correlation between preoperative anemia and PONV, and lacking a systematic analysis of multiple influencing factors. This study employed a prospective cohort design, including 400 LC patients, to clarify the correlation between preoperative anemia and PONV and comprehensively analyze potential influencing factors, providing evidence-based guidance for the precise clinical prevention and treatment of PONV, while enriching the prevention and control system for perioperative complications of LC.

2. Materials and methods

2.1. General information

A prospective cohort study design was used, selecting 400 patients who underwent elective LC in the hepatobiliary surgery department of our hospital from June 2024 to May 2026 as the study subjects.

2.1.1. Inclusion criteria

(1) Age 18 to 75 years;
(2) Diagnosed with benign diseases such as gallstones or chronic cholecystitis via ultrasound/CT;
(3) First-time LC with a smooth surgical procedure;
(4) Complete clinical data, with informed consent obtained and signed by the patient

2.1.2. Exclusion criteria

(1) Emergency surgery
(2) Comorbid gastrointestinal diseases, liver or kidney failure, or coagulopathy;
(3) History of blood transfusion or chemotherapy within 3 months before surgery;
(4) Allergy to anesthetics or antiemetics;
(5) Conversion to laparotomy or death within 24 hours postoperatively.

2.2. Definition of indicators

(1) Definition of preoperative anemia

According to the World Health Organization (WHO) criteria, anemia is defined as Hb < 130 g/L for males and Hb < 120 g/L for females.

(2) Diagnostic criteria for PONV

Nausea or vomiting occurring within 24 hours postoperatively, classified by severity as: mild (slight nausea without vomiting), moderate (nausea with 1–2 episodes of vomiting), and severe (severe nausea with ≥ 3 episodes of vomiting); PONV positivity is defined as moderate or severe vomiting.

2.3. Surgical and anesthesia methods

All patients underwent general anesthesia with tracheal intubation. Anesthesia induction: propofol 1.5–2.0 mg/kg, fentanyl 2–4 μg/kg, and rocuronium 0.6 mg/kg; anesthesia maintenance: intravenous infusion of propofol and remifentanil, maintaining a bispectral index (BIS) of 40–60. All surgeries were performed by the same surgical team, with routine establishment of a CO_2 pneumoperitoneum at a pressure of 12 mmHg, using a three-port technique, routine hemostasis, and no routine placement of a nasogastric tube. Postoperative analgesia was administered as needed using nonsteroidal or opioid analgesics based on pain levels.

2.4. Observation indicators

(1) Preoperative baseline data

Gender, age, smoking history, history of motion sickness, comorbidities (diabetes, hypertension), preoperative Hb, albumin, and Self-Rating Anxiety Scale (SAS) score.

(2) Intraoperative data

Surgical duration, anesthesia recovery time, and intraoperative hypotension (systolic blood pressure < 90 mmHg for ≥ 5 minutes).

(3) Postoperative data

Occurrence of PONV within 24 hours, use of postoperative analgesics, and pain score (NRS).

2.5. Statistical methods

Data analysis was performed using SPSS 27.0 software. Continuous data are presented as mean ± standard deviation ($\overline{x} \pm s$), with comparisons between groups using the *t*-test; categorical data are presented as rates (%), with comparisons between groups using the χ^2 test; ordinal data were compared using the rank-sum test. Univariate analysis was used to screen factors related to PONV, and factors with $p < 0.05$ were included in multivariate logistic regression analysis to identify independent risk factors. A p-value < 0.05 was considered statistically significant, with data rounded to two decimal places.

2. Results

2.1. Comparison of baseline data between the two groups

Among the 400 patients, 105 cases experienced PONV, with an overall incidence rate of 26.25%. There were 117 anemic patients, accounting for 29.25% of the total. In the PONV group, 38 patients were anemic, representing 35.18%; while in the non-PONV group, 79 patients were anemic, representing 26.77%. The incidence of PONV was higher in anemic patients compared to non-anemic patients, but the difference was not statistically significant. There were statistically significant differences in baseline data, such as gender, history of motion sickness, and postoperative opioid analgesia, between the two groups (all $p < 0.05$), as shown in **Table 1**.

Table 1. Comparison of baseline data between the two groups

Variable	PONV group (n = 105)	Non-PONV group (n = 295)	χ^2 value	*p* value
Preoperative anemia (yes)	38 (35.18%)	79 (26.77%)	3.314	0.069
Gender (female)	71 (68.31%)	161 (54.57%)	5.407	0.020

Age (< 50 years)	53 (50.47%)	131 (44.40%)	1.148	0.284
Smoking history (no)	36 (34.28%)	88 (29.83%)	0.719	0.397
Motion sickness history (yes)	19 (18.09%)	26 (8.81%)	6.681	0.010
Preoperative anxiety (yes)	16 (15.23%)	59 (20.00%)	1.153	0.283
Diabetes (yes)	18 (17.14%)	43 (14.57%)	0.395	0.530
Hypertension (yes)	24 (22.85%)	49 (16.61%)	2.025	0.155
Preoperative albumin (< 35g/L)	47 (44.76%)	105 (35.59%)	2.764	0.096
Operation time (> 90 min)	16 (15.23%)	48 (16.27%)	0.062	0.804
Postoperative opioid analgesia (yes)	41 (39.04%)	71 (24.06%)	8.620	0.003
Postoperative pain (NRS ≥ 4)	43 (40.95%)	108 (36.61%)	0.622	0.430
Anesthesia recovery time (> 30 min)	39 (37.14%)	109 (36.94%)	0.001	0.972
Intraoperative hypotension (yes)	9 (8.57%)	34 (11.52%)	0.704	0.401

2.2. Correlation between preoperative anemia and PONV and univariate analysis

Univariate analysis was conducted on factors such as preoperative anemia, gender, history of motion sickness, preoperative albumin, and postoperative opioid analgesia. The results showed that three factors, female gender, history of motion sickness, and the use of postoperative opioid analgesics, were significantly associated with PONV, as shown in **Table 2**.

Table 2. Univariate analysis of factors influencing PONV

Variable	PONV group (n = 105)	Non-PONV group (n = 295)	χ^2 value	*p* value	OR (95% CI)
Preoperative anemia (yes)	38 (36.19%)	79 (26.77%)	3.314	0.069	1.55 (0.97–2.49)
Gender (female)	71 (68.31%)	161 (54.57%)	5.407	0.020	1.74 (1.09–2.78)
History of motion sickness (yes)	19 (18.09%)	26 (8.81%)	6.681	0.010	2.29 (1.21–4.34)
Preoperative albumin (< 35 g/L)	47 (44.76%)	105 (35.59%)	2.764	0.096	1.47 (0.93–2.31)
Postoperative opioid analgesia (yes)	41 (39.04%)	71 (24.06%)	8.620	0.003	2.02 (1.26–3.25)

2.3. Multivariate logistic regression analysis of factors influencing PONV

Five potential influencing factors were included in the multivariate logistic regression analysis. The results indicated that female gender, motion sickness, and postoperative opioid analgesia were independent risk factors for PONV after LC ($p < 0.05$), as shown in **Table 3**.

Table 3. Results of multivariate logistic regression analysis

Variable	Adjusted OR	95% CI	*p* value
Anemia (yes vs no)	1.49	(0.92–2.42)	0.101
Gender (female vs male)	1.66	(1.03–2.69)	0.038
Motion sickness (present vs absent)	2.19	(1.15–4.16)	0.017
Low albumin (< 35 vs ≥ 35)	1.44	(0.92–2.27)	0.112
Opioid analgesia (present vs absent)	1.96	(1.22–3.15)	0.005

3. Discussion

Laparoscopic cholecystectomy (LC) is the mainstream minimally invasive surgical procedure for treating

benign gallbladder lesions in clinical practice. Postoperative nausea and vomiting (PONV), as one of the most common perioperative complications of this surgery, not only exacerbates patients' physical discomfort but may also interfere with the postoperative recovery process. Therefore, identifying the relevant influencing factors of PONV and implementing targeted prevention and control measures holds significant clinical practical value [3–5].

The results of this study indicate that the incidence of preoperative anemia in LC patients is 29.25%, and the incidence of PONV in LC patients is 26.25%. Among PONV patients, the proportion of anemic patients is 35.18%, which is higher than that of non-PONV patients, but the difference is not statistically significant. The reasons for this are analyzed as follows:

(1) The sample size is too small. Although there is a trend, the significance is not obvious, and a larger sample size is needed.

(2) Although we defined anemia, its severity was not differentiated. While anemia can cause gastrointestinal mucosal ischemia and hypoxia, damage to the mucosal barrier, gastrointestinal motility disorders, delayed gastric emptying, and easily induce nausea and vomiting, the anemia in most LC patients is not severe, so the impact in this regard is limited.

(3) Although some studies have shown that anemic patients have a more intense perioperative stress response, with sympathetic nervous system excitation exacerbating gastrointestinal dysfunction and increasing the risk of PONV, LC surgery, due to its short duration and minimal trauma, results in limited stress persistence and intensity, so anemia cannot play a synergistic role in this regard [6].

This study incorporated 14 common clinical indicators for grouped comparison and univariate analysis. The results confirmed that three factors, female gender, a history of motion sickness, and postoperative opioid analgesia, are significantly associated with the occurrence of PONV ($p < 0.05$). These factors cover multiple dimensions, including demographic characteristics, personal medical history, preoperative status, and surgery- and anesthesia-related indicators, confirming that PONV after LC is a complication caused by the combined effects of multiple factors, rather than being attributed to a single cause [7–9].

Further multivariate logistic regression analysis, after eliminating the interference of confounding variables, revealed that female gender, a history of motion sickness, and postoperative opioid analgesia are independent risk factors for PONV in LC patients ($p < 0.05$). Based on physiological characteristics, women have relatively higher estrogen levels, which can enhance the sensitivity of the central nervous system to external stimuli, making the vomiting center more easily activated. At the same time, women generally have higher vestibular function sensitivity, and when combined with the effects of surgical position changes and anesthetic drug stimulation, the probability of PONV is further increased. This conclusion is generally consistent with the views obtained from most current clinical studies and also suggests that female patients should be identified as a key population for PONV prevention and control in clinical practice [10]. Similarly, in patients with motion sickness, their vestibular system is more easily activated under surgical anesthesia, and the activated vestibular signals are directly transmitted to the vomiting center in the brainstem, triggering the nausea and vomiting reflex [11]. The use of postoperative opioid analgesia can directly stimulate the chemoreceptor trigger zone located in the area postrema of the brain, which is a receptor station for emetic signals. Once activated, it produces a feeling of nausea and vomiting and issues vomiting commands. At the same time, opioid drugs also significantly slow down gastrointestinal motility and emptying, leading to gastric content retention. This functional gastroparesis can cause abdominal distension and discomfort, which

are common causes of nausea and vomiting [12].

This study is a single-center prospective cohort study with a sample size of 400 cases. Although it meets the requirements of clinical research, it has certain limitations:

(1) Single-center data may have selection bias, and the results need to be verified by multicenter studies.

(2) No stratified analysis was conducted on the severity of8 anemia (mild, moderate, severe), making it impossible to clarify the dose-response relationship between different degrees of anemia and PONV.

(3) Gastrointestinal hormones, neurotransmitters, and other indicators were not detected, so the molecular mechanisms by which anemia induces PONV could not be explored in depth. In the future, multicenter, large-sample studies can be conducted to analyze the severity of anemia in strata and combine laboratory indicators to further reveal its mechanisms of action.

4. Conclusion

Preoperative anemia in patients undergoing laparoscopic cholecystectomy is not an independent risk factor for postoperative nausea and vomiting. However, female gender, a history of motion sickness, and postoperative opioid analgesia together constitute high-risk factors for PONV. Clinically, individualized perioperative management plans need to be formulated for high-risk patients, optimizing surgical anesthesia procedures and strengthening postoperative care to effectively reduce the incidence of PONV and promote rapid patient recovery.

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References

[1] Li N, Dou Y, Liu R, 2025, Comparative Study on the Short-Term Effects and Indicators of Body Stress Response Between Laparoscopic and Small-Incision Cholecystectomy for Gallstones. Henan Journal of Surgery, 31(1): 134–136.

[2] Zhan Z, Bao C, Tang H, et al., 2022, Analysis of 65 Cases of Clinical Experience and Technical Improvements in Stent-Free Laparoscopic Cholecystectomy + Common Bile Duct Incision and Stone Extraction with Primary Suture. Shanxi Medical Journal, 51(15): 1737–1739.

[3] Ni L, Li G, Bao Y, et al., 2026, Relationship Between Serum CCK, D-Lactic Acid, sICAM-1 and Postoperative Gastrointestinal Function Recovery in Elderly Patients Undergoing Laparoscopic Cholecystectomy. Chinese Journal of Gerontology, 46(10): 1745–1748.

[4] Qi X, Hu J, Jia J, 2026, Analysis of Risk Factors for Conversion to Laparotomy in Patients Undergoing Laparoscopic Cholecystectomy. Clinical Research and Practice, 11(14): 77–80.

[5] Ni S, 2026, Analysis of Risk Factors for Conversion to Laparotomy in Laparoscopic Surgery for Calculous

Cholecystitis. Zhejiang Journal of Traumatic Surgery, 31(4): 738–741.

[6] Chen L, 2024, The Effect of Electroacupuncture on Postoperative SIRS in Patients Undergoing Laparoscopic Radical Resection of Gastrointestinal Tumors, thesis, Fujian University of Traditional Chinese Medicine.

[7] Liu P, Liu F, Zhao X, et al., 2026, Establishment and Validation of a Nomogram Prediction Model for the Influencing Factors of Surgical Timing Selection and Postoperative Complication Risks in Early Versus Delayed Laparoscopic Surgery for Acute Cholecystitis Patients. Journal of Hepatobiliary Surgery, 34(1): 48–55.

[8] Li C, 2023, Comparison of Surgical Indicators and Postoperative Complications Between Primary Suture and T-Tube Drainage After Laparoscopic Common Bile Duct Incision and Stone Extraction for Common Bile Duct Stones. China Medical Innovation, 20(12): 112–115.

[9] Wang L, Ma L, Wang X, et al., 2026, Report of 1 Case of Deep Cystic Gastritis Diagnosed and Endoscopically Resected by Endoscopic Ultrasonography. Journal of Gastroenterology and Hepatology, 35(4): 519–521.

[10] Li H, Du Y, Lu Z, et al., 2022, The Effect of Different Postoperative Analgesic Methods on Postoperative Nausea and Vomiting in Female Patients Undergoing Laparoscopic Surgery. Inner Mongolia Medical Journal, 54(11): 1299–1304 + 1308.

[11] Sun Y, 2024, The Effect of Remifentanil Target-Controlled Infusion Combined with Ibuprofen Injection on Postoperative Nausea and Vomiting in Female Patients with Motion Sickness Undergoing Gynecological Laparoscopic Surgery, thesis, Jilin University.

[12] Ma J, Wei X, 2021, Research Progress on Opioid Receptor Antagonists in Preventing Postoperative Nausea and Vomiting After General Anesthesia. Clinical Journal of Military Medicine, 49(12): 1406–1408 + 1410.

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An Exploration of Leukorrhea in Women Based on the Yin-Yang Theory in Huangdi's Internal Classic

Jiayi Lei[1], Jiahui Xi[1], Weihua Gao[2]*

[1]Shaanxi University of Chinese Medicine, Xianyang 712000, Shaanxi, China
[2]The Second Affiliated Hospital of Shaanxi University of Chinese Medicine, Xianyang 712000, Shaanxi, China

Author to whom correspondence should be addressed.

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Abstract: The Huangdi's Internal Classic is a classic work of traditional Chinese medicine, and the theory of Yin and Yang is one of the important academic ideas in the Huangdi's Internal Classic, which is of fundamental significance for the interpretation of human life activities. When discussing the opposites, complementarity, interroot and interuse of Yin and Yang, Yang is dominant, emphasizing that Yang strengthens Yin and Yin is secret, Yang governs Yin. As the core theory of traditional Chinese medicine, it plays an important role in guiding the clinical practice of traditional Chinese medicine and in all aspects of understanding, prevention, and treatment of diseases. Leucorrhea is one of the common gynecological diseases in women, with complex and variable symptoms that have a significant impact on women's physical and mental health. The Huangdi's Internal Classic, a classic work of traditional Chinese medicine theory, has profound discussions and unique yin-yang theory explanations for leucorrhea. Based on the theory of Yin and Yang in the Huangdi's Internal Classic and in combination with modern medical research, this article will explore vaginal discharge in women, with the aim of providing new ideas and methods for clinical diagnosis and treatment.

Keywords: Huangdi's internal classic; Theory of Yin and Yang; Dai Xia; Leucorrhea

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1. Introduction

Yin and Yang are the natural laws of heaven and earth and the origin of nurturing life [1]. The concept of Yin and Yang originated in the era of Fuxi over 7,000 years ago. In Taoist culture, everything can be explained by the duality of Yin and Yang. The theory of Yin and Yang originated from the Huangdi's Internal Classic and is one of the foundations of the theoretical system of traditional Chinese medicine. It is both a worldview and a methodology, and the most fundamental logical thinking method for explaining its theories of physiology, pathology, diagnosis, treatment, and health preservation [2]. The Yellow Emperor's Inner Classic emphasizes

that the human body is closely and inseparably linked to the changes of Yin and Yang. It is mentioned in the Suwen: "When Yin and Yang are separated, the spirit is governed; When Yin and Yang are lost, vital energy is lost". Among them, "the balance of Yin and the secret of Yang" reveals an orderly homeostasis. The human body maintains self-regulation and relative stability in overall activity and function through a series of interaction mechanisms such as the opposition, interroot, interuse, waxing and waning, and transformation of Yin and Yang [3]. Yin and Yang are closely related to the body's physiology, pathology, and the treatment and prevention of diseases. Balance of Yin and Yang is the foundation of human health, and an imbalance of Yin and Yang leads to the occurrence of diseases. Only when Yin and Yang are in balance can the body maintain a normal state of health.

2. Women's belt overview below

The term "vaginal discharge" first appears in "Suwen - Gukong Lun": "The Ren meridian is a disease. In men, there is a hernia in the seven meridians; in women, there is a mass in vaginal discharge". From puberty, as the kidney Qi becomes more abundant, the Chong and Ren meridians become unobstructed, and a small amount of white or colorless transparent fluid appears in the vagina. The secretion increases before and after menstruation, between periods, and during pregnancy, which is physiological vaginal discharge. Physiological vaginal discharge has the effect of moistening the orifices of the vagina, ensuring that the genital area remains moist [4]. The term "leucorrhea" first appeared in "Treatise on the Etiology of Various Diseases", referring to a class of diseases in which there is a significant increase or decrease in the amount of vaginal discharge in women, abnormal color, quality, or odor, or accompanied by systemic or local symptoms [5]. This disease is often caused by dampness attacking the Ren and Dai meridians, causing the Ren meridian to be unstable and the Dai meridian to be out of control. Dampness is the main cause of this disease. The theory of Yin and Yang, as one of the core theories of traditional Chinese medicine, emphasizes that the human body is a whole of balanced Yin and Yang, and the imbalance of Yin and Yang is the fundamental cause of disease. The occurrence of leucorrhea is closely related to the imbalance of Yin and Yang. Therefore, exploring vaginal discharge in women from the perspective of the theory of Yin and Yang is of great significance for a deeper understanding of its etiology and pathogenesis and for guiding clinical diagnosis and treatment.

3. The relationship between the theory of Yin and Yang and vaginal discharge in women

The theory of Yin and Yang constitutes the core foundation of traditional Chinese medicine, and the imbalance of Yin and Yang is regarded as one of the fundamental pathological mechanisms in the theory of traditional Chinese medicine. The general principle of the Eight Principles of TCM syndrome differentiation is yin-Yang syndrome differentiation. Likewise, in the field of gynecology in traditional Chinese medicine, the theory of Yin and Yang plays a crucial role in exploring causes, pathological mechanisms, and conducting syndrome differentiation and treatment. In the cognitive system of etiology and pathogenesis in gynecology of traditional Chinese medicine, the imbalance of Qi, blood, Yin, and Yang in the Zang-fu organs is the key factor that causes diseases, among which the abnormality of the functions of the liver, spleen, and kidney is particularly important. For example, the imbalance of Yin and Yang in the kidney can cause many

gynecological disorders. When kidney Yang is deficient, there will be conditions such as menstrual edema, amenorrhea, and ovulatory infertility; Deficiency of kidney Yin can lead to problems such as amenorrhea, bleeding during the menstrual period, and infertility [6].

3.1. Etiology and pathogenesis of vaginal discharge

3.1.1. Invasion by external pathogenic factors

There are six kinds of pathogenic factors in nature: wind, cold, heat, dampness, dryness, and fire. When the Yin and Yang of the human body are out of balance and coordination, these pathogenic factors can invade the human body. Among all the pathogenic factors, dampness is most closely associated with leucorrhea. Dampness belongs to the Yin category, and its nature is similar to that of water, which has the characteristic of moving downward. Coupled with dampness itself being heavy, turbid, and sticky, its tendency to invade the human body downward is even more pronounced [7]. When the body's Yang Qi is insufficient and unable to transform water and dampness, or when it stays in wetlands for a long time, wades through water in the rain, etc., causing external dampness to invade the body, dampness descends into the uterine cavity and can cause abnormal vaginal discharge. "All dampness, swelling, and fullness belong to the spleen", as stated in the Suwen: The Great Treatise on the Essentials of Truth. Weakness of the spleen Yang, abnormal transformation of water and dampness, is a key factor in dampness-induced illness, reflecting the pathological change of imbalance of Yin and Yang, deficiency of middle Yang Qi leading to excess of Yin evil.

3.1.2. Internal injuries caused by the Seven emotions

Internal injury caused by the seven emotions can affect the internal organs, Qi, blood, Yin, and Yang. The smooth flow of Yin and Yang Qi and the harmony of Qi, blood, Yin, and Yang require normal physiological activities [8]. Changes in emotions such as anger, joy, pensiveness, sorrow, and fear can also cause dysfunction of the internal organs and imbalance of Yin and Yang. Such as liver depression and Qi stagnation, Qi stagnation turning into fire, liver fire disturbing downward, can cause the color of the vaginal discharge to turn yellow and thick; Or worry harms the spleen, and the spleen fails to function properly, causing internal water and dampness to descend into the vaginal discharge, resulting in an abnormal amount of vaginal discharge. This is a manifestation of the imbalance of Yin and Yang in the body caused by emotional factors, which in turn leads to leucorrhea.

3.1.3. Eating and overwork

Improper diet, excessive consumption of raw, cold, rich, and greasy foods can damage the Yang Qi of the spleen and stomach, leading to spleen Yang deficiency, failure of transformation and transportation, and internal generation of water and dampness. Overwork depletes vital energy, especially that of the spleen and lungs. The spleen is the foundation of the body after birth and the source of Qi and blood production. When the spleen is weak, it cannot transform the essence of food and water, and water dampness descends to form leucorrhea. This is due to the deficiency of Yin and Yang Qi and blood in the body caused by overeating and overworking, resulting in leucorrhea.

3.2. Clinical manifestations

The clinical manifestations of leucorrhea are diverse. Excessive leucorrhea is characterized by increased leucorrhea volume, abnormal color, quality, and odor of leucorrhea, and may also be accompanied by vulvar

pruritus, pain, burning, lumbago, abdominal pain, and other discomforts. Scanty vaginal discharge, vaginal itching, pain, and dryness may also cause changes in the menstrual cycle and volume, and decreased libido during the reproductive years. These symptoms are closely related to the imbalance of Yin and Yang and reflect the disorder of the internal environment of the body [9].

4. Classification of Yin and Yang in women's vaginal discharge

4.1. Leucorrhea is a syndrome of cold and Yin

Leucorrhea is often caused by a deficiency of Yang in the spleen and kidney. Kidney Yang is the root of all Yang Qi in the body. When kidney Yang is deficient and fails to warm the spleen earth, the spleen fails to function properly, water and dampness are retained internally and turn into a cold and damp pathogen, which descends to the uterus and causes leucorrhea. The characteristic of leucorrhea is that it is abundant in quantity, thin in texture, white in color, odorless, or fishy. Patients often have symptoms such as chills, cold limbs, soreness and weakness of the waist and knees, poor appetite, and loose stools, which are signs of Yang deficiency and Yin excess. The treatment should be based on warming the kidney and strengthening the spleen, removing dampness and stopping leucorrhea, such as Wandai Decoction, Neibu Pills, and other prescriptions, to restore the balance of Yin and Yang in the body by warming Yang and strengthening the essence, benefiting Qi, and removing dampness.

4.2. Yellow leucorrhea is a syndrome of Yang heat

Yellow leucorrhea is often caused by damp-heat descending or Yin deficiency with internal heat. Damp-heat pathogen, which belongs to the Yang pathogen, can be caused by external damp-heat or internal damp-heat. External damp-heat, such as during menstruation or postpartum when the blood vessels are empty, causes damp-heat to invade; Endogenous damp-heat is often caused by emotional distress, liver Qi stagnation, wood and earth congestion, depression turning into fire, and damp-heat descending through the liver meridian [10]. Damp-heat descending and damaging the Ren and Dai meridians can cause yellow vaginal discharge, which is yellow in color, thick and foul-smelling, often accompanied by symptoms such as vulvar pruritus, bitter mouth and dry throat, and short and red urine. If the yellow discharge is caused by Yin deficiency and internal heat, it is due to Yin deficiency of the liver and kidneys, internal false fire, boiling the body fluids, resulting in yellow and small discharge, accompanied by symptoms of Yin deficiency such as dry throat and mouth, hot flushes, night sweats, and hot palms and soles. For yellow leucorrhea caused by damp-heat descending, treatment mainly focuses on clearing heat and promoting diuresis, detoxifying and killing parasites, such as modified Zhidai Decoction, Longdan Xiegan Decoction, etc. For yellow leucorrhea caused by Yin deficiency with internal heat, it is advisable to nourish Yin and benefit the kidney, clear heat, and promote diuresis, such as the modified Zhibai Dihuang Pill.

4.3. Red and white leucorrhea is a sign of a mixture of Yin and Yang

Leucorrhea is more complex. It is often caused by long-term illness or insufficiency of vital energy, leading to an imbalance of Yin and Yang and disorder of Qi and blood. When there is an excess of wood in the liver, it overattacks the earth in the spleen; when blood is not stored, there is excessive damp-heat, and the vaginal discharge is red; Liver depression and spleen deficiency, excessive dampness, white vaginal discharge [11]. It may have a base of leucorrhea due to Yang deficiency and cold dampness, as well as red leucorrhea due

to Yin deficiency and hyperactivity of fire or damp-heat descending. If there is a deficiency of Yang in the spleen and kidney, with cold and dampness descending, and at the same time due to liver depression transforming into fire or long-term accumulation of damp-heat burning the blood vessels, there may be blood streaks in the leucorrhea, or a mixture of red and white. The treatment of such leucorrhea should be based on the specific situation of the imbalance of Yin and Yang, balancing the relationship between tonifying Yang and nourishing Yin, clearing heat and removing dampness, and comprehensively regulating Yin and Yang Qi and blood to achieve the purpose of stopping leucorrhea.

5. Modern medicine's understanding and treatment of leucorrhea

5.1. Modern medicine's understanding of leucorrhea

There is no exact corresponding disease in modern medicine. Modern medicine includes excessive vaginal discharge caused by some female reproductive system inflammations, such as vaginitis, cervicitis, endocrine disorders in Western medicine, and insufficient vaginal discharge caused by severe oophoritis, Sheehan's syndrome, etc., in the category of abnormal vaginal discharge [12]. "Leucorrhea" in modern medicine is called "vaginal discharge" or "vaginal secretions", and its formation is related to the effect of estrogen. If the vagina is damaged by labor, intrauterine operations, external pathogen infection, or low estrogen levels, local resistance can be reduced, leading to various types of vaginitis and cervicitis [13]. Infection factors mainly include microbial infections such as bacteria, fungi, and viruses; Endocrine disorders such as abnormal estrogen levels; and immune dysfunction factors such as autoimmune diseases, etc. These factors can cause an abnormal increase or decrease in vaginal discharge, accompanied by changes in color, quality, and odor, resulting in a variety of clinical manifestations in the female body.

5.2. Treatment of leucorrhea in modern medicine

The combination of traditional Chinese and Western medicine has a significant advantage in treating leucorrhea in current clinical practice. Traditional Chinese medicine focuses on the whole, regulating the balance of Yin and Yang, and restoring the normal functions of the body; Western medicine focuses on treating the cause of the disease, eliminating the pathogen and pathological changes. The combination and complementarity of the two can enhance the therapeutic effect.

5.2.1. TCM syndrome differentiation and treatment

Clinical prevention and treatment of diseases in traditional Chinese medicine focus on "strengthening the body's vital energy", combining the elimination of pathogenic factors with strengthening the body's vital energy, treating both symptoms and root causes, with the aim of fundamentally eliminating the disease, expelling the pathogenic factors, and restoring the body's vital energy [14]. When treating leucorrhea, the holistic concept, syndrome differentiation, and treatment are also emphasized. The treatment methods include internal administration of traditional Chinese medicine, external washing, acupuncture, etc. Individualized treatment is carried out based on the specific condition and constitution of the patient to achieve both symptomatic and root treatment. In addition, traditional Chinese medicine also focuses on prevention and conditioning. By adjusting the patient's diet, lifestyle, and emotions, it regulates the balance of Yin and Yang and restores the normal functions of the body to achieve the purpose of treating leucorrhea.

5.2.2. Western medicine anti-infection treatment

Western medicine treats infections by targeting infection factors. Clinical guidelines mainly use oral or vaginal topical antibacterial, fungal, or other antimicrobial drugs, and even emphasize the repeated use of drugs before and after menstruation and in multiple cycles, such as antibiotics, to kill pathogens and eliminate the source of infection [15]. At the same time, Western medicine focuses on regulating endocrine and immune functions and improving the internal environment of the body.

5.2.3. Integrated treatment combining traditional Chinese and Western medicine

The combination of traditional Chinese and Western medicine can give full play to the advantages of both and improve the clinical treatment effect. Both Chinese and Western medicine have their own characteristics in treatment. Western medicine shows an effect slightly faster than Chinese medicine, but it has a higher recurrence rate and is prone to drug resistance [16]. Chinese medicine, on the other hand, requires syndrome differentiation and treatment. It takes a little longer to show effect, but the therapeutic effect is stable and has the characteristics of a low recurrence rate and few adverse reactions [17]. On the one hand, the holistic concept and syndrome differentiation treatment of traditional Chinese medicine can provide useful references and guidance for Western medical treatment; On the other hand, the modern science and technology and treatment methods of Western medicine can also provide strong support for traditional Chinese medicine treatment. By regulating the balance of Yin and Yang through syndrome differentiation and treatment in traditional Chinese medicine and eliminating pathogens and pathological changes through anti-infection treatment in Western medicine, the two complement each other and can jointly promote the recovery of patients.

6. Conclusion

Leucorrhea is one of the common gynecological diseases in women. Its etiology and pathogenesis are complex and changeable. The theory of Yin and Yang in the Huangdi's Internal Classic provides an important theoretical basis for the diagnosis and treatment of leucorrhea. Clinically, the treatment of leucorrhea can be achieved by regulating the balance of Yin and Yang to restore the normal physiological functions of the body. The modern medical understanding of leucorrhea also provides new ideas and methods for the integrated treatment of traditional Chinese and Western medicine. Therefore, in clinical practice, full attention should be paid to the application of the theory of Yin and Yang, combined with modern medical research, to constantly explore and innovate treatment methods and improve the therapeutic effect of leucorrhea.

Disclosure statement

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References

[1] Yuan Y, Zhai F, Guo M, et al., 2023, Hu Yuquan on the Treatment of Postpartum Wind-Middle Syndrome Based on the Theory of Balancing Yin and Yang. Global Journal of Chinese Medicine, 16(09): 1822–1825.

[2] Sun K, Zhang X, Zhao X, 2014, Some Discussions on the Logical Thinking of Yin and Yang Theory in Huangdi's

Internal Classic Method. Journal of Henan Normal University (Philosophy and Social Sciences Edition), 41(5): 44–49.

[3] Gao Z, Rong R, 2017, An Analysis of "Yin and Yang Secrets". Chinese Journal of Traditional Chinese Medicine, 32(07): 2975–2977.

[4] Yang J, 1986, Pathogenesis, Syndrome, and Treatment of Vaginal Discharge Disease. Sichuan Journal of Traditional Chinese Medicine, 1986(03): 7–8.

[5] Yang J, Luo J, Liu G, 2023, Zhang Zhiyuan's Experience in Typing and Treating Vaginal Discharge. Chinese Journal of Traditional Chinese Medicine, 64(21): 2176–2178 + 2188.

[6] Xu K, Shi Y, Tian D, et al., 2022, Female, Yin and Yang Attributes of Progesterone Explore. Journal of Shandong University of Chinese Medicine, 46(5): 593–596.

[7] Chen H, Li Y, Tang Q, et al., 2023, Similarities and Differences in Pathogenesis of Dampness Invading Different Parts of the Body and Western Medicine Understanding. Journal of Beijing University of Chinese Medicine, 46(07): 954–959.

[8] Li Y, Liu Z, Wang Y, et al., 2024, Discussion on the Treatment of Anxiety-Induced Insomnia with "Balancing Yin and Yang and Soothing Emotions" Massage. Shandong Traditional Chinese Medicine, 43(5): 446–450.

[9] Wang F, Liu C, 2021, Treatment of Leukorrhagia Experience. Journal of Inner Mongolia Traditional Chinese Medicine, 40(9): 114–116.

[10] Wei Y, Xie G, Zhu F, 2021, Zhejiang Sent Famous Leukorrhagia Xu Rongzhai Treatment Experience of Traditional Chinese Medicine Analysis. Journal of Zhejiang University of Chinese Medicine, 45(3): 253–255.

[11] Xu X, Wang R, He S, et al., 2018, Analysis of the Treatment of Red and White Leucorrhea from the Perspective of Liver and Spleen in Fu Qingzhu's Gynecology. Chinese Journal of Traditional Medicine in Asia Pacific, 14(11): 90–92.

[12] Chu C, Yang X, Yuan Y, et al., 2023, Leukorrhagia Diagnostic and Therapeutic Features. Chinese Journal of Preclinical Medicine of Traditional Chinese Medicine, 29(12): 1997–2000.

[13] Zhou X, Liu Y, Huang X, et al., 2017, Analysis of Integrated Traditional Chinese and Western Medicine Teaching Methods for Leucorrhea in Gynecology of Traditional Chinese Medicine. Modern Distance Education of Traditional Chinese Medicine, 15(12): 33–34.

[14] Shao X, Yang X, 2020, Research Progress on the Pathogenesis Theory of Leucorrhea Based on the New System of Complex Pathogenesis Theory of Traditional Chinese Medicine. Sichuan Journal of Chinese Medicine, 38(11): 221–222.

[15] Ma Y, Wang H, Gao Y, 2024, Exploring the Medication Patterns of Traditional Chinese Medicine in Treating Leukorrhea Based on Data Mining. China Journal of Traditional Chinese Medicine Library and Information Science, 48(06): 104–108.

[16] Wang T, Zhang X, 2016, Clinical Observation on the Treatment of Trichomonas Vaginitis with Modified Fumigation and Washing of Cnidium Monnieri Powder Combined with Metronidazole. Hebei Medicine, 22(06): 1012–1014.

[17] Wang H, Cheng L, Ding Y, et al., 2020, Clinical Research Progress of Traditional Chinese Medicine in the Treatment of Vulvar and Vaginal Inflammatory Diseases. Hubei Journal of Traditional Chinese Medicine, 42(09): 61–66.

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Analysis of Clinical Characteristics and Prognostic Risk Factors of Pediatric Rhabdomyosarcoma

Lanlan Su
Wuming Hospital Affiliated to Guangxi Medical University, Nanning 530100, Guangxi Zhuang Autonomous Region, China

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Abstract: Rhabdomyosarcoma is a common malignant soft tissue tumor in the field of pediatric hematological oncology. It has an insidious onset and complex and diverse clinical manifestations, and its prognosis is affected by many factors, which seriously endangers children's physical and mental health. With the rapid development of medical informatization, online databases have become an effective way to integrate multi-center clinical data and conduct large-scale research, providing a convenient and efficient research approach for the clinical study of pediatric rhabdomyosarcoma. From the perspective of clinical physicians and based on the discipline of pediatric hematological oncology, this paper analyzes the current clinical research status of pediatric rhabdomyosarcoma, and deeply studies the clinical significance and practical approaches of conducting research on this disease by using online databases. It aims to provide theoretical support for the improvement of clinical diagnosis and treatment in hospitals and the establishment of prognostic evaluation systems, so as to help improve the standardized diagnosis and treatment level of pediatric rhabdomyosarcoma and optimize the quality of life of sick children.

Keywords: Online database; Prhabdomyosarcoma; Clinical characteristics; Prognostic risk factors

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1. Introduction

Pediatric hematological tumors are major, serious diseases endangering children's lives and health. Rhabdomyosarcoma is the most common soft tissue sarcoma in children, falling within the scope of diagnosis and treatment of pediatric hematological oncology. It has a complex pathogenesis and diverse clinical phenotypes, and there are great differences in disease progression, treatment response, and prognosis among different sick children. In clinical work in hospitals, the diagnosis and treatment of pediatric rhabdomyosarcoma face many difficulties. Its early symptoms are not typical and can be easily confused with other benign soft tissue lesions in children, which easily leads to delayed diagnosis of some children and misses the best treatment opportunity. Moreover, the prognosis of the disease is affected by many

factors such as tumor location, pathological type, treatment regimen, and individual physical constitution of children. Therefore, accurate identification of prognostic risk factors is of great significance for improving treatment regimens and optimizing the prognosis of sick children. With the continuous advancement of medical informatization construction, online databases are gradually applied in clinical research of pediatric hematological oncology due to their advantages of large data storage capacity, convenient retrieval, and integration of multi-center resources. They not only overcome the problems of small sample size and narrow research scope in traditional single-hospital research, but also comprehensively analyze the clinical characteristics of pediatric rhabdomyosarcoma, providing a new research platform for exploring prognostic risk factors.

2. Current clinical research status of pediatric rhabdomyosarcoma

Rhabdomyosarcoma is a malignant tumor formed by rhabdomyocytes or mesenchymal cells differentiated toward rhabdomyocytes. It has obvious age distribution characteristics, mostly occurring in infants and adolescents, and is the most common malignant soft tissue tumor in childhood, accounting for a certain proportion of childhood malignant tumors. From the perspective of hospital clinical diagnosis and treatment practice, pediatric rhabdomyosarcoma shows obvious heterogeneity. Tumors can occur in all parts of the human body, and there are great differences in the incidence of different parts [1]. Most of the early symptoms are atypical, often manifested as painless masses, local swelling, and pain, which are easily misdiagnosed as benign cysts, inflammation, and other diseases, resulting in the diagnosis of some children only in the middle and late stages of the disease, which also increases the difficulty and risk of treatment. At present, the treatment of pediatric rhabdomyosarcoma has formed a comprehensive treatment model dominated by surgery, chemotherapy, and radiotherapy. With the development of medical technology, new treatment methods such as immunotherapy and targeted therapy have also been applied clinically, which have improved the quality of life of patients to a certain extent [2]. However, high-risk, recurrent, refractory, and metastatic rhabdomyosarcoma is still an important disease that seriously threatens the health and life of children and adolescents, with a relatively high mortality rate. From the perspective of research, most traditional studies on pediatric rhabdomyosarcoma are based on small-sample clinical data of a single hospital, with the disadvantages of small sample size, poor representativeness of research results, and difficulty in data integration. They cannot well reflect the overall clinical characteristics and prognosis of the disease, nor can they effectively identify various factors affecting prognosis [3]. With the development of medical informatization, the establishment and application of online databases have provided an effective way to solve this problem. Online databases can integrate clinical data of pediatric rhabdomyosarcoma from hospitals in different regions and at different levels. The database includes various data such as basic information of sick children, clinical symptoms, pathological characteristics, treatment regimens, and follow-up results, laying a foundation for large-sample and multi-center clinical research. At present, research based on online databases has become an important research direction in the field of pediatric rhabdomyosarcoma. By sorting out and analyzing massive clinical data in online databases, we can better understand the clinical characteristics of the disease and find out the relationship between different clinical indicators and prognosis, providing more reliable theoretical support for the improvement of clinical diagnosis and treatment strategies and the establishment of prognostic evaluation systems [4]. However, there are also problems, such as a low

degree of data standardization, uneven data quality, and difficulty in privacy protection in the application process, which need continuous improvement and perfection in the research process.

3. Clinical significance of researching pediatric rhabdomyosarcoma based on online databases

3.1. Helping improve the cognition of clinical characteristics

The clinical manifestations of pediatric rhabdomyosarcoma vary greatly. Different lesion locations and pathological types lead to great differences in clinical symptoms, disease progression speed, and therapeutic effects. Traditional small-sample research of a single hospital is difficult to fully reflect these differences, resulting in limitations in clinicians' overall understanding of the disease. Research based on online databases can collect multi-center and large-sample clinical data, covering cases in various regions and age groups, as well as cases with different lesion locations [5]. Comprehensive analysis of these data can help clinicians summarize the phenotypic rules of pediatric rhabdomyosarcoma more comprehensively and find out the distribution of various clinical characteristics, thus effectively making up for the limitations of single-hospital research. From the perspective of hospital clinicians, a comprehensive understanding of the clinical characteristics of pediatric rhabdomyosarcoma is an important prerequisite for early diagnosis, accurate classification, and individualized treatment. Massive data in online databases enable clinicians to have a clearer understanding of the pathogenesis, symptom manifestations, and classification differences of the disease, effectively avoiding misdiagnosis and missed diagnosis caused by insufficient clinical experience and providing more comprehensive reference for clinical diagnosis [6]. In addition, data analysis using online databases can also identify clinical features overlooked in previous small-sample studies, enrich the clinical knowledge of pediatric rhabdomyosarcoma, provide new perspectives for early detection and differential diagnosis of diseases, and promote in-depth clinical research in the field of pediatric hematological oncology [7].

3.2. Providing support for accurate identification of prognostic risk factors

Traditional research is limited by a small sample size, making it difficult for clinicians to comprehensively and accurately screen key factors affecting prognosis and clarify the interaction between different risk factors. Online databases gather massive follow-up data of children with rhabdomyosarcoma, providing sufficient sample support for the study of prognostic risk factors. Through multi-dimensional analysis of data, it can help clinicians systematically screen risk factors closely related to the prognosis of sick children, clarify the intensity and mechanism of each factor, so as to construct a more scientific and comprehensive prognostic evaluation system [8]. For hospital clinicians, prognostic risk factors obtained from online databases can be used to evaluate the prognostic risk of sick children quickly. Clinicians can formulate more individualized treatment and follow-up plans for high-risk children, strengthen disease monitoring in subsequent treatment, and adjust treatment plans in a timely manner, which can effectively reduce the incidence of adverse prognosis [9].

4. Practical paths of researching pediatric rhabdomyosarcoma based on online databases

4.1. Screening of online databases and data integration

To carry out research on pediatric rhabdomyosarcoma smoothly, researchers first need to select appropriate

online databases, which is the premise of ensuring research quality. Doctors can select suitable online databases according to the actual needs of hospital clinical research. The selected databases should have the characteristics of large data volume, wide coverage, complete data types, timely updates, and high security. At the same time, priority should be given to professional databases related to pediatric hematological oncology and containing clinical data of rhabdomyosarcoma, and ensure that the data sources are legal and standardized and can be used after strict review [10]. After determining the database, start data extraction and integration. Determine the scope and content of data extraction according to research purposes, mainly including basic information of sick children, clinical symptoms, pathological examination results, treatment regimens, follow-up conditions, and other multifaceted data [11]. Unified data extraction standards shall be formulated during data extraction, and the data extraction process shall be standardized. Experienced clinicians shall be assigned to perform data extraction to avoid research deviation caused by inadequate and inconsistent data extraction. Meanwhile, the extracted general data shall be sorted and cleaned to remove invalid information, duplicate information, and abnormal information, so as to ensure the integrity and accuracy of data [12]. In addition, data from different databases need to be standardized with a unified data format and coding to eliminate data differences and realize effective data integration, so as to finally obtain standardized research datasets and lay a good foundation for the analysis of clinical characteristics and the study of prognostic risk factors.

4.2. Theoretical analysis of clinical characteristics and prognostic risk factors

After data integration, systematic theoretical analysis shall be conducted on the data in online databases from the perspective of pediatric hematological oncology, combined with hospital clinical diagnosis and treatment experience. Specifically, in the analysis of clinical characteristics, we mainly start from the aspects of age distribution, gender differences, lesion location, clinical symptoms and pathological types of sick children, summarize the distribution rules and internal relations of different clinical characteristics combined with the pathogenesis and clinical diagnosis and treatment characteristics of pediatric rhabdomyosarcoma, so as to find out the phenotypic differences of the disease and provide theoretical support for clinical diagnosis and classification [13]. At the same time, scientific theoretical analysis methods can be adopted to screen tumor-related factors, treatment-related factors, and individual factors affecting prognosis, combined with clinical practice experience, and deeply analyze the correlation between each factor and prognosis so as to find out the mechanism of each risk factor [14]. In the process of analysis, attention shall be paid to the combination of theory and clinical practice, fully consider the actual situation of hospital clinical diagnosis and treatment, and ensure that the analysis results can provide a feasible reference for clinical work. At the same time, attention should be paid to the interaction among various factors, and the synergistic or antagonistic effects among various risk factors should be determined to provide a theoretical basis for establishing a comprehensive prognostic evaluation system and help clinicians evaluate the prognosis of sick children more accurately.

4.3. Verification and clinical transformation of research results

After completing data integration and theoretical analysis, it is necessary to verify the results to ensure their reliability and accuracy scientifically. The verification process can adopt a multi-center verification method, selecting clinical cases of pediatric rhabdomyosarcoma from hospitals in different regions and

different levels to verify the summarized clinical characteristic rules and prognostic risk factors, compare the consistency between verification results and research conclusions, and correct deviations in the research in a timely manner to optimize research conclusions [15]. At the same time, cases in our own hospital can be selected for verification, combined with hospital clinical practice, to make research conclusions closer to the actual diagnosis and treatment of the hospital, and improve the practicality of research results. In terms of clinical transformation, apply the summarized clinical characteristic rules to clinical diagnosis, optimize early diagnosis and differential diagnosis procedures, and improve the accuracy of early diagnosis and reduce the incidence of misdiagnosis and missed diagnosis. At the same time, it is necessary to apply the screened prognostic risk factors to clinical prognostic evaluation, establish an individualized prognostic evaluation model, and allow clinicians to accurately judge the prognostic status of sick children and formulate appropriate treatment and follow-up plans. Finally, it is necessary to apply the effective treatment rules found in the research to the improvement of treatment regimens, enrich the comprehensive treatment system of pediatric rhabdomyosarcoma, and optimize therapeutic outcomes. In addition, research results should be linked with the diagnosis and treatment specifications in the field of pediatric hematological oncology to promote the popularization and application of research achievements, raise the overall diagnosis and treatment level of various hospitals, and ultimately achieve the goals of improving the quality of life of sick children and reducing disease mortality.

5. Conclusion

Pediatric rhabdomyosarcoma is a common malignant soft tissue tumor in the field of pediatric hematological oncology, with complex clinical manifestations and numerous prognostic influencing factors, which seriously endangers children's physical and mental health. A comprehensive understanding of its clinical characteristics and accurate identification of prognostic risk factors are of great significance for improving clinical diagnosis and treatment level. With the rapid development of medical informatization, online databases can provide a new impetus for clinical research of pediatric hematological oncology. They have the advantages of large data volume, wide coverage, and convenient integration, which can well solve the limitations of small-sample research in a single hospital and lay a good foundation for large-sample and multi-center research on pediatric rhabdomyosarcoma.

Disclosure statement

The author declares no conflict of interest.

References

[1] Zha Y, Su Y, Jiang M, 2025, Analysis of Radiotherapy Setup Error and External Margin of Pediatric Rhabdomyosarcoma in Head and Neck. Chinese Journal of Medical Physics, 42(10): 1261–1265.

[2] Yang Q, Han Y, Zhang A, et al., 2025, Efficacy Analysis of Re-Treatment After Recurrence of Pediatric Non-Metastatic Rhabdomyosarcoma. Journal of Pediatric Hematology and Oncology, 30(05): 330–335.

[3] Yuan X, Yang N, Lang H, et al., 2025, Clinical Research of Circulating Tumor Cells in Pediatric Rhabdomyosarcoma. Journal of Pediatric Hematology and Oncology, 30(02): 109–114.

[4] Ma M, Gong J, Jiao W, 2023, A Case of B-ALL Recurrence After Remission of Rhabdomyosarcoma in Children. Clinical Oncology Journal, 28(06): 572–574.

[5] Liu S, 2023, Clinical Characteristics and Prognostic Analysis of 20 Cases of Rhabdomyosarcoma, thesis, Central South University.

[6] Liu S, Ye F, Fan C, et al., 2022, Clinical Characteristics and Prognostic Analysis of 20 Children with Rhabdomyosarcoma. Chinese Journal of Contemporary Pediatrics, 24(09): 1036–1041.

[7] Wu J, Wang J, Mao J, et al., 2022, Progress of Targeted Therapy Clinical Trials for Pediatric Rhabdomyosarcoma. Chinese New Drugs Journal, 31(15): 1480–1486.

[8] Wang Y, Gong X, Yin C, 2022, Clinical Characteristics and Prognosis of Pediatric Rhabdomyosarcoma. Henan Medical Research, 31(07): 1211–1214.

[9] Zhen H, 2022, Radiotherapy for Pediatric Rhabdomyosarcoma, thesis, Peking Union Medical College.

[10] Peng Y, Peng Y, Yin Y, 2022, Survival Prediction of Pediatric Rhabdomyosarcoma After Chemotherapy Based on Three-Dimensional Radiology. Journal of Practical Clinical Medicine, 26(02): 113–118.

[11] Liu C, Xu C, Ning Y, 2021, A Case of Dental Dysplasia After Chemoradiotherapy for Submental Rhabdomyosarcoma. Chinese Journal of Stomatological Research (Electronic Edition), 15(05): 296–299.

[12] Zeng W, Ma J, Ming C, 2021, Analysis of Clinical Characteristics of Pediatric Nasal Rhabdomyosarcoma. Chinese Archives of Otolaryngology-Head and Neck Surgery, 28(09): 545–548.

[13] Li N, Huang L, Deng Q, 2021, Palliative Treatment of One Case of Pediatric Embryonal Rhabdomyosarcoma of Nasal Cavity and Paranasal Sinus. Sichuan Medical Journal, 42(09): 959–961.

[14] Shi Y, Xiao R, Peng S, et al., 2021, A Case of Pediatric Alveolar Rhabdomyosarcoma of Maxillofacial Region and Literature Review. Beijing Journal of Stomatology, 29(04): 256–258.

[15] Zhang L, Xiong H, Li J, et al., 2021, Construction and Verification of Prognostic Model for Pediatric Rhabdomyosarcoma. Clinical Oncology Journal, 26(07): 622–628.

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The Application of Dynamic Artificial Intelligence-Assisted Ultrasound Examination in the Diagnosis of Breast Lesions

Zhengying Sun, Meng Sun*

Hongqi Hospital Affiliated to Mudanjiang Medical University, Mudanjiang 157000, Heilongjiang, China

Author to whom correspondence should be addressed.

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Abstract: Early accurate diagnosis of breast lesions is the core link to reducing the harm of malignant breast lesions and improving patients' prognosis. Relying on deep learning, real-time image recognition, and dynamic image analysis technologies, dynamic artificial intelligence-assisted ultrasound examination can intelligently analyze dynamic breast ultrasound images, automatically locate lesions, extract imaging features of lesions, and assist in differentiating benign and malignant lesions, making up for the inherent shortcomings of traditional ultrasound examination from a technical perspective. On this basis, this paper studies the application of dynamic artificial intelligence-assisted ultrasound examination in the diagnosis of breast lesions, analyzes the practical problems existing in traditional ultrasound examination for breast lesion diagnosis, explains the clinical application value of dynamic artificial intelligence-assisted ultrasound examination, and puts forward targeted application countermeasures for technical popularization, so as to promote the steady development of breast lesion diagnosis toward standardization, precision and high efficiency.

Keywords: Dynamic artificial intelligence; Ultrasound examination; Breast lesions; Clinical diagnosis; Auxiliary application

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1. Introduction

Breast diseases are common illnesses among contemporary women. As the main clinical manifestation of hyperplasia of mammary glands, nodules, tumors, and other pathological changes, the benign and malignant identification results of breast lesions directly affect the formulation of patients' treatment plans and the protection of physical and mental health. Breast diseases are characterized by insidious onset and atypical early symptoms, and most malignant lesions evolve from benign lesions. Only through early screening, early identification, and early diagnosis can the risk of severe breast diseases be reduced at the source and the health of female groups be safeguarded. With unique clinical advantages, ultrasound examination meets

the breast screening demands of women of all ages, and is especially suitable for lesion detection in dense breast tissue. It can clearly display the organizational structure of mammary glands, lesion morphology, and the correlation with surrounding tissues, and has long occupied an irreplaceable position in the initial screening and routine diagnosis of breast lesions [1]. Therefore, exploring the application of dynamic artificial intelligence-assisted ultrasound examination in the diagnosis of breast lesions is of great significance.

2. Problems of traditional ultrasound examination in the diagnosis of breast lesions

2.1. Prominent subjectivity in diagnosis and excessive dependence on personal experience

The whole process of traditional breast ultrasound examination centers on manual operation, lacking rigid objective standards for image acquisition quality, identification of lesion features, and judgment of benign or malignant tendency, which leads to strong subjectivity. Sonographic manifestations of breast lesions are diverse and complicated, and the sonographic features of benign and malignant lesions overlap greatly without obvious dividing lines, putting forward high requirements for doctors who need sufficient summarization capability to make accurate disease identification. Due to discrepancies in practical experience and professional knowledge, different doctors may draw vastly different conclusions for the same image. Junior physicians struggle to distinguish subtle structural changes of tumors and are prone to misdiagnosis; senior physicians with abundant experience tend to form fixed thinking modes in diagnosis in the absence of unified criteria [2]. In addition, doctors' working status and psychological factors can influence their image interpretation, making it hard for traditional ultrasonic diagnosis to maintain objectivity and rigorousness all the time, and resulting in unstable overall diagnostic quality.

2.2. Insufficient identification of tiny and occult lesions and limited capacity for early diagnosis

Early breast lesions mostly present as tiny and occult lesions featured by small volume, atypical echo characteristics, indistinct boundaries with normal surrounding mammary gland tissues, and absence of typical signs such as obvious calcification and abnormal blood flow. Conventional manual ultrasonic scanning relies on naked-eye observation and manual inspection by physicians, which hardly captures subtle structural differences in images and easily leads to missed diagnosis. Besides, some lesions are hidden in special positions such as the breast margin and deep gland layers; incomplete scanning range or improper probe angle adjustment by physicians may cause lesion omission. Traditional ultrasound has poor recognition performance for atypical early lesions and lesions with low malignant tendency, and can only detect typical lesions with obvious features, failing to realize ultra-early screening of breast diseases and delaying the optimal diagnosis and treatment timing.

2.3. Inconsistent implementation of diagnostic criteria and poor consistency of clinical diagnosis

Though unified clinical grading diagnostic criteria for breast imaging are available, their implementation varies greatly under traditional manual ultrasonic diagnosis. Medical institutions and clinicians differ in their understanding and judgment of grading standards, lacking unified evaluation criteria for indicators, including lesion boundary regularity, morphological normality, internal echo, and peripheral adhesion. Different diagnosis results for identical ultrasound images are commonplace: the same breast ultrasound

image may obtain totally different grading results and treatment suggestions from different physicians. Such a situation not only causes overdiagnosis of benign lesions, increasing patients' psychological stress and medical expenses, but also may result in missed diagnosis and misdiagnosis of malignant diseases, delaying treatment. Furthermore, ultrasound equipment from different manufacturers adopted in various hospitals brings about inconsistent examination outcomes, hindering data sharing, patient referral, and subsequent follow-up [3].

3. Application value of dynamic AI-assisted ultrasound in breast lesion diagnosis

3.1. Effectively improving overall diagnostic accuracy

Trained by massive breast ultrasound image data, the algorithm of dynamic artificial intelligence-assisted ultrasound examination can build a standardized database of lesion features and get rid of over-reliance on personal experience in manual diagnosis. The system captures and displays real-time images of all scanning phases, automatically marks suspicious areas, and precisely extracts diversified image information, including morphology, marginal features, echo intensity, calcification, and blood flow, detecting subtle abnormalities invisible to human eyes [4]. With unified algorithm-based data processing and benign-malignant risk analysis free from doctors' emotions, experience deviation, and visual fatigue, the intelligent system provides objective and standardized diagnostic references. Combined with patients' clinical symptoms and past medical history, clinicians make comprehensive judgments to effectively lower misdiagnosis and missed diagnosis rates and realize precise, refined, and reliable diagnosis of breast lesions [5].

3.2. Simplifying diagnosis and treatment procedures

Traditional manual breast ultrasound involves cumbersome steps of manual scanning, frame-by-frame image reading, and manual data recording and analysis, consuming a long time for single-case inspection. It cannot satisfy the efficiency demand of large-scale physical examination and mass breast screening for women, causing long waiting queues and insufficient screening coverage. Dynamic artificial intelligence-assisted ultrasound realizes integrated intelligent processing of scanning, imaging, analysis, and annotation, completes standardized full-breast scanning automatically, and generates image analysis reports instantly, greatly simplifying manual workflow and shortening single inspection duration. Operating stably without interruption regardless of human physical limits, the intelligent system efficiently undertakes large-scale screening tasks, expands the coverage of general breast screening, and promotes regular early screening of breast diseases [6].

3.3. Standardizing clinical diagnosis and treatment

Embedded with standardized diagnostic models complying with breast imaging grading specifications, dynamic artificial intelligence-assisted ultrasound quantifies and standardizes the evaluation of various lesion indicators to unify diagnostic criteria among medical institutions of different regions and grades. Both community clinics and large general hospitals can implement diagnosis following unified standards with auxiliary intelligent equipment to eliminate inconsistent interpretation and ambiguous criteria of traditional ultrasound. Meanwhile, the system dynamically monitors scanning procedures and image quality, standardizing probe scanning paths and shooting angles to ensure uniform image collection. Intelligent diagnostic reports support one-click filing and classified archiving for medical record inquiry, inter-hospital

consultation, and follow-up tracking, laying a foundation for programmed, standardized, and normalized development of breast ultrasound examination [7].

4. Application strategies of dynamic AI-assisted ultrasound in breast lesion diagnosis

4.1. Standardizing diagnostic procedures and strengthening whole-process quality control

In accordance with the technical characteristics of dynamic artificial intelligence-assisted ultrasound, the full diagnostic workflow of breast lesions is standardized to strengthen quality management and ensure all diagnostic links conform to clinical specifications [8]. Firstly, formulate standardized diagnostic processes covering ultrasonic scanning of lesion sites, image acquisition, artificial intelligence processing, physician diagnosis, result feedback, and document archiving for future reference. Standardize probe operation routes and manipulation to achieve full coverage of suspicious areas and avoid diagnostic omission or error for a higher lesion detection rate [9]. Secondly, construct a quality assessment system for lesion detection, assign special teams to audit the intelligent system's differential diagnosis capacity and physicians' diagnostic results, especially for small and atypical lesions so as to correct wrong diagnoses timely; standardize medical record contents with mandatory items including lesion features, AI analytical conclusions and doctors' interpretation opinions to form unified and complete documents supporting subsequent clinical treatment and follow-up. Unified standards for dynamic lesion observation are set up to realize dynamic comparison via data storage function for reexamination and curative effect evaluation, forming a closed-loop management system covering screening, diagnosis, and follow-up [10]. Moreover, strengthen supervision over technical application in medical institutions and urge standardized implementation of examinations in line with industrial codes to facilitate normative development of dynamic artificial intelligence-assisted ultrasound technology [11].

4.2. Developing hierarchical professional training to improve practitioners' application capability

The medical staff's operating ability directly determines the clinical application effect of dynamic artificial intelligence-assisted ultrasound, which requires systematic hierarchical training to improve professional skills. First of all, hospitals formulate targeted training plans based on actual conditions for ultrasound practitioners to realize capability matching. For newly employed and junior medical workers, popularized training focuses on intelligent equipment operation, basic image reading, intelligent report interpretation, and common lesion identification to help them master core techniques for routine examination and preliminary diagnosis. For senior radiologists and backbones, training highlights algorithm principles, intelligent result analysis, human-machine collaborative reading, and differential diagnosis of complicated lesions, guiding rational utilization of AI tools without blind dependence or complete rejection of intelligent assistance to maximize the value of artificial intelligence while improving personal diagnosis level [12]. In addition, organize training through seminars, case discussions, practical operations, and remote teaching with lectures delivered by specialists from the medical imaging and artificial intelligence industries; display typical clinical cases and provide human-machine interactive experience of AI-assisted diagnosis to accelerate practitioners' proficiency in relevant technology. Build WeChat groups for doctors to exchange experiences and solve

practical problems together, and create a mutually improving working atmosphere. Incorporate technical proficiency into performance appraisal to motivate active learning and fully release the application value of the technology [13].

4.3. Promoting multidisciplinary collaboration to expand technical application scope

As an independent diagnostic tool, dynamic artificial intelligence-assisted ultrasound needs multidisciplinary cooperation to integrate medical resources, expand applicable scenarios, and elevate clinical value. Firstly, boost interdisciplinary collaboration between the ultrasound department and breast surgery, pathology, medical imaging, oncology, and other disciplines to build multidisciplinary treatment (MDT) teams. Integrate real-time AI-assisted ultrasonic diagnosis data with pathological examination, mammography, breast MRI, and other inspection results for comprehensive assessment to improve diagnostic accuracy and formulate individualized treatment plans. Combined application of multiple testing methods overcomes the limitations of a single examination and improves the overall diagnosis and treatment level of breast diseases [14]. Secondly, expand application scenarios beyond routine breast lesion screening and diagnosis to follow-up monitoring and curative effect evaluation. The technology dynamically tracks changes in lesion size and hemodynamic parameters to assess treatment outcomes and adjust therapeutic regimens in a timely manner for scientific evidence of subsequent treatment. It is also applicable in regular screening of high-risk groups with family inheritance history and endocrine disorders to increase the early detection rate of breast cancer and realize early diagnosis and treatment. Thirdly, facilitate the technical integration of artificial intelligence, 5G, big data, and telemedicine to realize remote diagnosis, automatic follow-up tracking, and case sharing, popularize the technology, especially in grassroots hospitals, and comprehensively improve the diagnosis and treatment capacity of breast diseases [15].

5. Conclusion

In summary, as an important integration achievement of smart medical care and medical imaging, dynamic artificial intelligence-assisted ultrasound examination has outstanding clinical advantages in improving diagnostic accuracy, boosting screening efficiency, unifying diagnostic criteria, and standardizing treatment procedures, providing an innovative technical route for early screening and precise diagnosis of breast lesions, and bearing practical significance for protecting women's breast health. Relevant authorities should improve industrial specifications, optimize equipment algorithms, implement hierarchical professional training, and strengthen data privacy protection to promote standardized clinical promotion of this technology. In future development, artificial intelligence technology shall be further integrated into a multidisciplinary diagnosis mode and applied throughout the whole chain of breast lesion screening, diagnosis, follow-up, and efficacy evaluation.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhao Y, 2025, Preliminary Application of Breast Ultrasound AI Recognition System in Real-Time Breast Ultrasonic Examination, thesis, Hebei Medical University.

[2] Jia X, 2024, Research on Migration Decision-Making Method Based on Multi-Level Parameters, thesis, Hefei University of Technology.

[3] Li L, 2023, Application Value of Artificial Intelligence Combined with Ultrasound Images in Classification of Breast Lesions, thesis, Kunming Medical University.

[4] Zhou H, 2024, Research on Segmentation and Classification of MRI Breast Lesions Based on Deep Learning, thesis, Shandong Technology and Business University.

[5] Liu Y, 2024, Study on Efficacy Prediction of Neoadjuvant Therapy for Breast Cancer Using Terahertz and Ultrasound Data, thesis, University of Electronic Science and Technology of China.

[6] Li X, Zhao J, Ren J, 2024, Application of Dual-Mode Ultrasound Deep Learning Prediction Model in Breast Cancer Diagnosis. Chinese Journal of Clinical Research, 37(03): 365–369 + 374.

[7] Li X, 2024, Research on Application of Dual-Mode Ultrasound Deep Learning Prediction Model in Breast Cancer Diagnosis, thesis, Jinzhou Medical University.

[8] Li W, 2024, Diagnostic Value of Artificial Intelligence S-Detect Combined with Contrast-Enhanced Ultrasound in Benign and Malignant Differentiation of Breast Masses, thesis, Shihezi University.

[9] Shen J, Liu Y, Mo M, et al., 2023, Effectiveness of Artificial Intelligence-Assisted Ultrasound for Breast Lesion Detection in Chinese Women. China Oncology, 33(11): 1002–1008.

[10] Jin Q, Lü J, Xu L, 2023, Influences of Different Ultrasonic Imaging Parameters on S-Detect Technology for Benign and Malignant Identification of Breast Nodules. Journal of Practical Medicine, 39(22): 2891–2897.

[11] Wang H, Yang X, Chen F, 2023, Research Progress of Artificial Intelligence in Auxiliary Diagnosis of Breast Imaging. Chinese Journal of Medical Imaging, 31(10): 1113–1116.

[12] Liao W, Zhu Y, Xu J, 2023, Patent Analysis of Breast Cancer Analysis and Prediction Based on Artificial Intelligence. China Science and Technology Information, 2023(18): 56–58.

[13] Bian J, Jiang J, He X, 2023, Application Value of Yizhun Intelligent Software in Benign and Malignant Differentiation of Category 4 Breast Nodules. Chinese Journal of Ultrasound in Medicine, 39(07): 750–754.

[14] He X, 2023, Research on Key Technology of Automatic 3D Imaging Report Generation Based on Conventional Breast Ultrasound, thesis, Chinese PLA Medical School.

[15] Liu R, Yuan W, Liu W, 2022, Application of Ultrasonic Diagnostic System Based on AI Deep Learning Algorithm in Benign and Malignant Differentiation of Non-Palpable Breast Nodules. Journal of Zhengzhou University (Medical Sciences).

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Current Situation Analysis of Eye Health Management Integrated with Psychotherapy

Hongli Wang, Wenyuan Wei, Wenbin Sun

CAPF Tianjin Corps Hospital, Tianjin 300300, China

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Abstract: There are neural connections between the visual pathway and the emotional regulation system, and ocular organic diseases and psychological problems interact bidirectionally. Against the background of excessive use of electronic products, increasing mental stress, and population aging, the incidence of visual fatigue, dry eye, glaucoma, fundus diseases, and other eye diseases is rising and tending to be younger. Chronic eye diseases, visual impairment, and medical burden are prone to induce negative emotions, while psychological stress can aggravate eye diseases through mechanisms such as neuroinflammation and endocrine disorders, forming a vicious circle. At present, China's eye health management is transforming into a full-cycle and integrated service model, but clinical practice still has the limitation of attaching importance to treatment while neglecting psychology. Although psychological intervention is effective, it faces practical problems such as disciplinary barriers, a lack of screening, insufficient talent, and the absence of unified standards. This paper puts forward strategies such as integrated diagnosis and treatment, hierarchical intervention, and interdisciplinary collaboration, so as to provide theoretical and practical reference for constructing a mind-body integrated ophthalmology diagnosis and treatment model, making up for the shortcomings of psychological services, and improving the full-life-cycle eye health service system.

Keywords: Eye health management; Psychological intervention; Ophthalmic and psychological comorbidity; Psychosomatic medicine; Interdisciplinary diagnosis and treatment

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1. Introduction

Vision is the core perceptual function of the human body. Its conduction pathway is closely connected with the brain's emotional regulation area at anatomical, neural, and immunological levels, and psychological emotional fluctuations can directly affect the homeostasis of the ocular internal environment [1]. With the transformation of modern lifestyle, factors such as long-term close eye use, high-intensity work pressure, and high incidence of chronic diseases in the elderly have led to the continuous increase of various functional and irreversible chronic eye diseases. The pathogenesis of eye diseases is no longer limited to simple organic damage, and psychological and social factors play key roles in the occurrence, progression, and recurrence of

eye diseases [2].

Clinical studies have shown that most patients with chronic eye diseases are accompanied by varying degrees of depression, anxiety, poor sleep quality, and somatic symptoms, which directly affect clinical treatment compliance and long-term rehabilitation outcomes [3]. Traditional ophthalmology clinical practice mainly focuses on physical treatment such as medication, surgery, and optical correction, while ignoring the assessment and targeted intervention of patients' psychological state for a long time, making it difficult to break the vicious cycle of mutual aggravation between eye diseases and psychological problems. In this context, integrating psychological intervention into the whole-process eye health management and constructing a new mind-body collaborative diagnosis and treatment model has become a research hotspot in the fields of ophthalmology and psychosomatic medicine. Based on domestic and foreign research achievements in recent years, this paper systematically sorts out the current situation, existing bottlenecks, and development direction of the integration of eye health management and psychotherapy, so as to provide a reference for clinical practice.

2. Comorbidity mechanism and epidemiological status of eye diseases and psychological disorders

2.1. Epidemiological characteristics of comorbidity

With the continuous development of psychosomatic medicine, a number of large-sample clinical surveys have confirmed the epidemiological characteristics of eye diseases complicated with psychological abnormalities. Compared with healthy people, patients with various eye diseases have a significantly higher incidence of anxiety, depression, insomnia, and somatic symptoms. The comorbidity ratio and severity of emotional disorders are closely related to the type and course of eye diseases, degree of visual function damage, and treatment burden, showing distinct disease differentiation characteristics.

Dry eye disease has the highest clinical incidence and is most closely associated with psychological factors among psychosomatic eye diseases. Epidemiological data show that the prevalence of dry eye among Chinese adults exceeds 30%, and the prevalence among long-time desk workers and screen-dependent groups is more than 50%. Patients with dry eye suffer from intractable discomfort, such as dry eyes, burning sensation, foreign body sensation, fluctuating vision, and photophobia, with recurrent symptoms that are difficult to cure completely. They are prone to emotional sensitivity, irritability, and decreased concentration. Long-term physical discomfort limits daily social activities and outdoor travel, reduces work efficiency, lowers patients' willingness to socialize and self-identity, and eventually induces anxiety and depression. Multiple cross-sectional surveys show that the incidence of anxiety in patients with moderate and severe dry eye reaches 45–60%, the incidence of depression exceeds 35%, and the proportion complicated with sleep disorders is over 70%. Mild emotional problems are prevalent, and the detection rate of moderate and severe psychological comorbidity remains high [4].

As a lifelong irreversible blinding eye disease, glaucoma has a more prominent ophthalmic and psychological comorbidity problem. It is characterized by progressive visual field defect and optic nerve atrophy, which cannot be completely cured, with a potential lifelong risk of vision loss. Patients are trapped in the fear of blindness, helplessness of lifelong disease, and psychological burden of long-term medication, staying in a high-stress state for a long time. Clinical studies have shown that the comorbidity rate of anxiety and depression in patients with primary open-angle glaucoma and angle-closure glaucoma is significantly

higher than that of patients with common chronic diseases. Emotional fluctuation and mental tension are independent risk factors for sudden elevation of intraocular pressure and accelerated optic nerve damage, forming a vicious cycle of emotional fluctuation, increased intraocular pressure, aggravated condition, and intensified anxiety.

Severe visual impairment diseases, such as diabetic retinopathy and age-related macular degeneration, directly affect patients' daily self-care ability. Coupled with the long-term economic pressure of treatment, they greatly increase the risk of severe psychological problems such as severe depression and pessimism. Elderly patients have a narrow social circle and weak social support. They are more likely to feel lonely and desperate when facing vision decline, which further aggravates psychological disorders and seriously affects disease prognosis [5].

Among adolescents, high myopia incidence, binocular visual dysfunction, and persistent visual fatigue are closely related to academic load and emotional depression. Psychological imbalance is an important inducement for accommodation spasm, visual fatigue, and pseudomyopia. High-intensity mental tension causes continuous contraction and spasm of extraocular muscles and ciliary muscles, aggravating visual fatigue and refractive errors; while long-term blurred vision aggravates adolescents' inferiority and learning anxiety, hindering physical and mental health development [6]. Young and middle-aged workplace groups suffer from long-term high-pressure work, emotional internal friction, and staying up late, resulting in long-term autonomic nervous disorder, which is also an important psychological inducement for intractable visual fatigue and meibomian gland dysfunction.

Ocular lesions and emotional disorders form bidirectional regulation through multiple pathways. From the perspective of immune inflammation, negative emotions induce the release of pro-inflammatory mediators such as tumor necrosis factor and interleukin, destroy the stability of the ocular epithelial barrier, and aggravate chronic inflammation of dry eye and fundus diseases; long-term ocular chronic stimulation continuously activates the central emotional regulation area and induces abnormal emotional regulation [7].

At the level of endocrine regulation, negative emotions such as anxiety and depression over-activate the hypothalamic-pituitary-adrenal axis, causing hormone disorder and ocular peripheral vasoconstriction, reducing ocular surface blood supply and optic nerve tolerance to damage, and accelerating the progression of glaucoma and retinopathy [8]. Meanwhile, autonomic nervous disorder leads to abnormal tear secretion and ocular muscle accommodation spasm, inducing functional eye diseases such as visual fatigue, forming a bidirectional pathogenic closed loop.

3. Current situation of domestic eye health management

3.1. Gradual establishment of a full-chain health management system

In recent years, the state has attached great importance to national visual health, issued a number of special eye health policies, continuously improved the public service network of eye health, and promoted the transformation of China's eye health management from traditional post-onset treatment to the full-cycle management mode of early prevention, early screening, early intervention, and long-term follow-up, with a preliminary full-chain service system established.

Primary medical institutions regularly carry out vision screening for adolescents, fundus disease screening for the elderly, and screening of ocular complications of chronic diseases, establish health files for high-risk groups, and realize dynamic monitoring and management. Ophthalmic specialized institutions

implement standardized management measures such as long-term follow-up, individualized medication guidance, and lifestyle intervention for chronic eye diseases such as glaucoma, dry eye, and diabetic retinopathy, effectively delaying the decline of visual function and reducing the risk of mass blindness. Relying on internet technology, online medical services are gradually popularized, breaking time and space constraints, and providing long-term convenient health management services for patients with chronic and elderly eye diseases.

3.2. Shortcomings of current eye health management

The current eye management model still has obvious shortcomings. Firstly, the diagnosis and treatment concept is one-sided, focusing on the examination and symptomatic treatment of ocular organic lesions, while psychological screening is not included in the routine diagnosis and treatment process of chronic eye diseases, resulting in a prominent missed diagnosis of psychological comorbidity. Secondly, the interdisciplinary collaboration mechanism is imperfect. There is no regular consultation and two-way referral mechanism between ophthalmology and psychology/psychiatry, and there is a lack of psychological assessment norms adapted to ophthalmology scenarios [9]. Thirdly, the service coverage for different groups is unbalanced, and the combined eye and mental health management services for high-pressure professionals, chronic disease patients, and low-vision elderly groups are insufficient. Finally, health science popularization content is single, mostly focusing on eye disease prevention and scientific eye use, lacking publicity on the correlation between emotional stress and eye health.

4. Application status of psychological intervention in ophthalmology clinical practice

4.1. Common psychological intervention technologies and applications

At present, non-drug psychological intervention schemes adapted to ophthalmology clinical practice have been gradually improved. Cognitive behavioral intervention is the most widely used clinical technology, which can correct patients' negative cognition and catastrophic thoughts about diseases, alleviate disease fear and diagnosis and treatment anxiety, stabilize autonomic nerve function, and significantly improve the treatment compliance of patients with chronic glaucoma and fundus diseases.

Mindfulness stress reduction training, biofeedback therapy, and short-term relaxation training are simple and time-saving, suitable for outpatient rapid intervention. They can effectively improve the physical discomfort and mental tension of patients with visual fatigue and dry eye.

For patients with moderate emotional abnormalities, short-term focused intervention and group psychological counseling can alleviate disease stigma and loneliness. For patients complicated with severe anxiety and depression, professional psychiatrists can conduct an evaluation and adopt a combined drug and psychological counseling scheme to realize simultaneous physical and mental treatment.

4.2. Clinical application effect and research progress

A large number of controlled clinical trials have confirmed that combined psychological intervention on the basis of routine ophthalmic treatment can effectively improve tear secretion indicators, stabilize intraocular pressure fluctuation, relieve ocular muscle accommodation spasm, and reduce the recurrence risk of functional eye diseases. Foreign countries have incorporated psychological state assessment into

the standardized management of chronic glaucoma and macular degeneration, confirming that long-term emotional management can delay the progression of visual function damage. Domestic-related research has gradually focused on psychosomatic eye diseases such as dry eye and central serous chorioretinopathy, verifying that early emotional intervention can shorten the course of disease and reduce drug dependence, with good clinical application value.

4.3. Practical obstacles to clinical promotion

The large-scale implementation of psychotherapy in ophthalmology still faces many restrictions. On the one hand, ophthalmic medical staff generally lack systematic psychological professional training, with insufficient ability to identify hidden emotional problems, and cannot carry out basic psychological counseling. On the other hand, professional psychological medical resources are generally in short supply, and psychological specialists cannot cover ophthalmic outpatient and long-term chronic disease follow-up scenarios, resulting in high intervention costs and insufficient accessibility. In addition, unified diagnosis and treatment guidelines for eye diseases complicated with psychological abnormalities have not been issued in China, lacking standardized intervention schemes, treatment courses, and efficacy evaluation criteria, restricting the standardized promotion of relevant technologies.

5. Prominent problems in the integration of eye health management and psychotherapy

5.1. Highly solidified medical division mode and insufficient popularization of the mind-body treatment concept

Traditional clinical specialty division takes the organ system as the core. Ophthalmology focuses on local organ lesions, while psychology focuses on mental and emotional diseases. Long-term divided diagnosis and treatment lead to fragmented diagnosis and treatment thinking. Hospital management has not attached importance to the construction of interdisciplinary disciplines. Psychological intervention has always been defined as auxiliary and supplementary treatment, not included in the standardized diagnosis and treatment path of chronic eye diseases, and lacking institutional support for integrated development.

5.2. Absence of a full-process psychological screening system and weak early intervention capacity

Psychological and emotional assessment links are not set in all procedures, including physical examination, primary screening, and specialized diagnosis and treatment. There is a lack of simple screening tools adapted to rapid ophthalmic diagnosis and treatment. Mild psychological problems remain hidden for a long time until developing into severe comorbidities, missing the optimal time for early intervention.

5.3. Severe shortage of compound professional talents

There is a huge gap in compound talents who master both ophthalmology professional knowledge and psychological assessment, basic counseling, and psychosomatic disease diagnosis and treatment capabilities. The continuing education system is disconnected: ophthalmology continuing education lacks mental health courses, while psychological professionals lack basic medical and ophthalmic knowledge, with a blank interdisciplinary talent training mechanism [10,11].

5.4. Deep-rooted patients' cognitive misconceptions and insufficient treatment compliance

Affected by traditional health concepts, most patients believe that eye diseases only need ocular treatment, regard psychological counseling and emotional intervention as redundant treatment, and show strong resistance. Some patients have a stigma of mental illness, deliberately hide negative emotions, and refuse psychological assessment and intervention, seriously affecting the progress of integrated diagnosis and treatment.

5.5. Imperfect evaluation system and difficulty in quantifying the value of integrated diagnosis and treatment

The existing ophthalmic efficacy evaluation indicators are mainly objective physical indicators such as intraocular pressure, visual acuity, fundus structure, and tear indicators, without incorporating comprehensive mind-body indicators such as quality of life, emotional state, sleep quality, and treatment compliance. It is difficult to quantify the long-term benefits of psychological intervention, restricting policy support and clinical promotion.

6. Countermeasures and future development trends of integrated development

6.1. Construction of an integrated interdisciplinary diagnosis and treatment mode of ophthalmology and psychology

Break the discipline segmentation, establish a regular joint consultation mechanism between ophthalmology and clinical psychology/psychiatry. Incorporate simple emotional scale screening into routine examination items of chronic and recurrent eye diseases. Formulate psychological intervention operation specifications for common eye diseases such as dry eye, glaucoma, and visual fatigue according to disease characteristics, and promote the standardized and normalized implementation of mind-body collaborative treatment.

6.2. Implementation of hierarchical and precise psychological intervention

Establish a hierarchical intervention scheme according to the severity of emotional abnormalities: patients with mild emotional tension and anxiety receive health education and basic emotional counseling by ophthalmic medical staff; patients with moderate psychological abnormalities receive professional intervention through short-term psychotherapy; patients with severe ophthalmic and psychological comorbidity implement two-way referral, adopting combined drug and psychological intervention therapy.

6.3. Strengthen talent training and national health science popularization

Incorporate psychosomatic medicine and basic mental health knowledge into the continuing education of ophthalmology, and carry out training on simple psychological assessment and counseling skills for ophthalmic medical staff. Carry out multi-channel health science popularization, popularize the correlation between emotional stress and eye diseases, correct cognitive misconceptions, and improve patients' recognition and acceptance of psychological intervention [12,13].

6.4. Improve the long-term management system based on smart medical care

Rely on digital means such as internet medical treatment and online follow-up to establish long-term eye and mental health files for patients with chronic eye diseases, realize simultaneous monitoring of emotional

state and ocular condition outside the hospital, provide remote counseling, improve the full-cycle integrated management system, and reduce disease recurrence rate [14,15].

7. Conclusion

Eye health and mental health are highly integrated. Psychological factors run through the whole process of the occurrence, development, and rehabilitation of eye diseases, forming a close two-way regulatory relationship. China's eye health management service system continues to be improved, and the application value of psychological intervention in the diagnosis and treatment of ophthalmic comorbidities has been widely verified. However, there are still many problems, such as lagging diagnosis and treatment concepts, insufficient disciplinary collaboration, uneven resource allocation, and a lack of standardized norms. In the future, it is necessary to change the traditional single physical treatment thinking, accelerate the in-depth integration of eye health management and psychological intervention, build an integrated service model of screening, diagnosis, intervention, and rehabilitation, comprehensively improve the quality of life and rehabilitation outcomes of eye disease patients, and boost the high-quality development of the national eye health cause in China.

Disclosure statement

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References

[1] Chen X, Yang Y, 2026, Research on the Shared Mechanism of the Eye-Brain Axis and Mental Disorders. Chinese Journal of Behavioral Medicine and Brain Science, 35(2): 185–190.

[2] Liu J, Zhou Y, 2024, Correlation Analysis of Psychological Factors and Functional Eye Diseases. Chinese Journal of Ophthalmology and Otorhinolaryngology, 24(3): 221–225.

[3] Wang X, Chen L, 2025, Research Progress on Pathogenesis and Psychosomatic Integrated Treatment of Glaucoma Complicated with Anxiety and Depression. International Journal of Ophthalmology, 25(10): 1785–1789.

[4] Zhao C, Li X, 2025, Research Progress on the Application Value of Psychosomatic Therapy in Dry Eye Disease. Frontier Medicine, 12(8): 12–17.

[5] Zhang M, 2025, Research Progress on the Correlation Between Macular Diseases and Emotional Disorders. Chinese Journal of Ophthalmology, 61(9): 712–717.

[6] Alrawashdeh H, 2022, Digital Eye Strain and Mental Health Status in the General Population. Frontiers in Public Health, 10: 895517.

[7] Li H, 2024, Research on the Comorbidity Mechanism of Dry Eye and Depression Mediated by Neuroinflammation. Chinese Journal of Psychiatry, 30(5): 310–315.

[8] Yin Y, Yu A, Ge S, 2026, Intervention Effect of Solution-Focused Brief Therapy Combined with Artificial Tears on Dry Eye Patients Complicated with Anxiety. International Journal of Psychiatry, 53(1): 278–281.

[9] Jesus J, Ambrosio J, Meira D, 2026, The Hidden Psychiatric Burden in Glaucoma Patients. Revista de Saude Publica, 60: 39857700.

[10] Cai H, Wang B, Chen P, et al., 2025, Analysis of Domestic and Foreign Research Status and Future Development

Trend of Home Health Management of Non-Communicable Eye Diseases. Journal of Disease Prevention and Control, 2025(1): 10–12.

[11] Liu T, 2024, Commissioner Campaign · Small Category Leverages Big Market — Grand Finale of Xingqi Eye Health Management Commissioner Creation Camp Successfully Closed. Chinese Pharmacy Journal, 2024(11): 82–85.

[12] Zhang H, Shan X, Chen T, et al., 2024, Practice and Discussion on the Construction of Hospital-Community Integrated Eye Health Management Service System. Chinese Journal of Social Medicine, 41(1): 25–28.

[13] Jiang M, Li Y, Li M, et al., 2024, Analysis on Current Situation and Influencing Factors of Health Management in Patients with Diabetic Retinopathy. Qilu Journal of Nursing, 30(6): 23–29.

[14] Yang C, Huang Y, Zheng W, 2024, Application Status and Analysis of Information-Based Health Management System in Day Surgery Patients with Glaucoma. Digital Medicine and Health, 02(04): 224–230.

[15] Xiao X, 2024, Full Life Cycle Eye Health Management. Population and Health, 2024(12): 88–92.

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Flow Rate Control and Optimization of RCA Infusion System Based on ADRC and Two-Stage Calcium Supplementation Model

Chao Xu[1], Damin Ding[2,3], Chaobin Wang[2]

[1]Shanghai Institute of Medical Device Testing, Shanghai 201318, China
[2]Shanghai University of Engineering Science, Shanghai 201620, China
[3]Shanghai Superb Medical Technology Co., Ltd., Shanghai 201612, China

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Abstract: Based on the established two-stage mathematical model of Regional Citrate Anticoagulation (RCA), an automated RCA infusion system is constructed. Aiming at the flow rate accuracy problem of peristaltic pumps under variable pressure environments, a flow rate control algorithm based on Active Disturbance Rejection Control (ADRC) is designed, combined with pressure compensation and surface calibration methods. The experimental results show that this method can achieve high-precision infusion under different pressure differences and meet clinical requirements.

Keywords: RCA; ADRC; Flow control; Continuous renal replacement therapy

Online publication: Jun 30, 2026

1. Introduction

Safe and effective anticoagulation is the key technical difficulty of blood purification, especially for long-term Continuous Renal Replacement Therapy (CRRT). Regional Citrate Anticoagulation (RCA) has been proven to have an effective extracorporeal anticoagulant effect, which can avoid long-term exposure to heparin during continuous renal replacement therapy [1]. In addition to reducing the incidence of dialysis-related bleeding, RCA can also improve the service life of dialyzers and enhance their biocompatibility [2]. The internationally authoritative Kidney Disease: Improving Global Outcomes (KDIGO) organization issued clinical guidelines for acute kidney injury in 2012, recommending RCA as the preferred anticoagulation method for patients with acute kidney injury, especially those with hemodynamic instability, undergoing CRRT treatment [3].

The key technical point in the implementation of RCA is to determine appropriate infusion rates of citrate and calcium, so as to maintain the ion calcium concentration *in vivo* and extracorporeal circulation within a proper and narrow therapeutic target range. A mathematical model for predicting *in vivo* citrate

concentration has been established in previous studies [4]. Based on this mathematical model, this study constructs a dual-pump automated RCA infusion system, explores the infusion precision technology of the RCA infusion system, and discusses flow rate control technology with the help of the test environment and test means of the Shanghai Institute of Medical Device Testing. The improved Active Disturbance Rejection Control (ADRC) algorithm is adopted to enhance the anti-interference ability of peristaltic pump flow precision [5–7]. Meanwhile, real-time compensation is performed for the infusion rates of citrate solution and calcium chloride solution, aiming at the complex positive and negative pressure differences before and after the pump, so as to improve infusion accuracy.

2. RCA infusion system

2.1. Hardware design

The structure of the RCA infusion system is shown in **Figure 1**. Its hardware system mainly includes a power supply, a main board, a storage battery, a motor, a touch screen, sensors, and other components. On both sides of the device are respectively equipped with citrate pump, bubble sensor, air pressure sensor, liquid level sensor, pinch valve, as well as calcium chloride pump, bubble sensor, liquid level sensor, and pinch valve. On the back of the device are the chassis fixing module, cooling fan air outlet, and external power interface. The device is internally equipped with lithium-ion storage batteries.

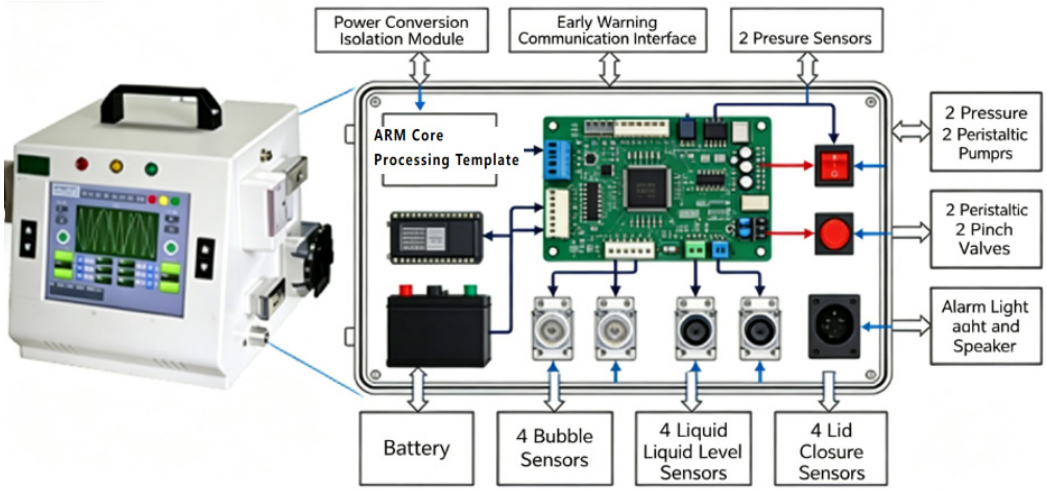


Figure 1. Composition of the RCA infusion system.

2.2. Software design

The core board adopted by the RCA infusion system runs the Debian 8.6 operating system. The main functions of the core board include operating the main program containing the two-stage model, processing sampling data, controlling actuators, recording data, and running the alarm monitoring module. The software structure is shown in **Figure 2**.

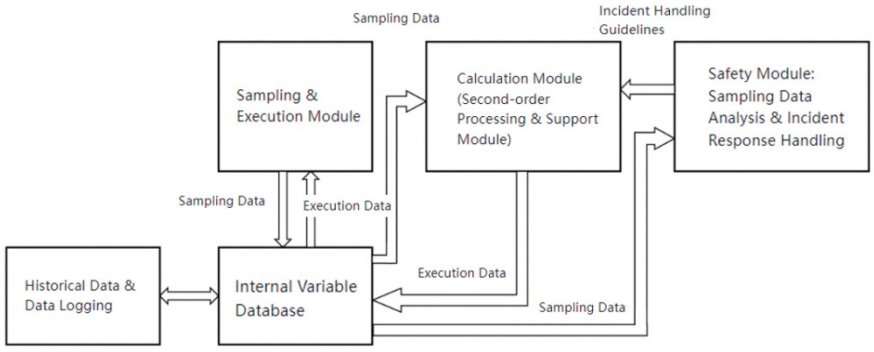


Figure 2. Schematic diagram of software structure.

3. Flow rate control and optimization based on the ADRC algorithm

3.1. ADRC design

The key indicator of the RCA infusion system lies in the infusion speed accuracy of the two peristaltic pumps. The infusion speed of the peristaltic pump is the most direct output of the two-stage theoretical model, which determines the core performance of the equipment. The peristaltic pump adopts a brushless DC motor matched with a machined pump head, enabling smooth and stable operation.

Figure 3 shows the basic structure of the second-order active disturbance rejection controller, where r represents the input, y represents the system output, k_p and k_d are the proportional coefficient and differential coefficient in the simplified PD control combination, ESO stands for Extended State Observer, and u is the control variable.

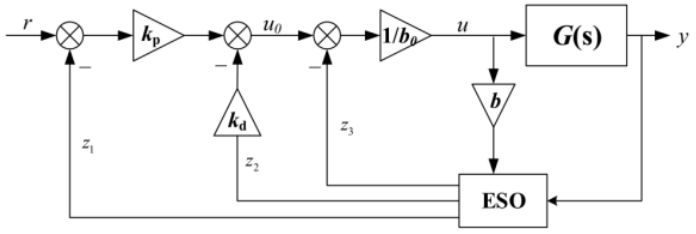


Figure 3. Structure diagram of the second-order linear active disturbance rejection controller.

The second-order controlled object G(s) is approximated according to the second-order active disturbance rejection controller:

$$\ddot{y} = f\left(y, \dot{y}, \omega, t\right) + bu = -a_1\dot{y} - a_0 y + \omega + bu \tag{1}$$

where y and u are output and input, respectively, and ω denotes disturbance. The parameter b contains a known part b_0, namely. $b = b_0 + \left(b - b_0\right)$. Select the state variables: $x_1 = y, x_2 = \dot{y}$, $x_3 = f$, then $x = [y \quad \dot{y} \quad f]^T$.

$$\begin{cases} \dot{x} = Ax + Bu + E\dot{f} \\ y = Cx \end{cases} \tag{2}$$

Where:

$$A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & 0 & 0\end{bmatrix},\ B=\begin{bmatrix}0\\ b_0\\ 0\end{bmatrix},\ E=\begin{bmatrix}0\\ 0\\ 1\end{bmatrix},\ C=\begin{bmatrix}1 & 0 & 0\end{bmatrix}$$

The corresponding continuous linear extended state observer is:

$$\begin{cases}\dot{z}=Az+Bu+L\left(y-\hat{y}\right)=Az+Bu+L\left(y-Cz\right)\\ \hat{y}=Cz\end{cases} \tag{3}$$

where is the error feedback gain matrix of the observer, taken as:

$$L=\begin{bmatrix}\beta_1 & \beta_2 & \beta_3\end{bmatrix}^T=\begin{bmatrix}3\omega_0 & 3\omega_0^2 & \omega_0^3\end{bmatrix}^T \tag{4}$$

3.2. Pressure detection and compensation

The peristaltic pump is calibrated in the laboratory environment, with rotating speed as input and actual flow rate of standard liquid as output, and the calibration results show good repeatability. However, in the actual application environment, the output end of the peristaltic pump is connected to CRRT or iHD equipment. The citrate end is connected to the arterial end of CRRT/iHD, and the calcium chloride end is connected to the venous end of CRRT/iHD. The other ends of the two pumps are connected to the lead-out pipeline of human blood vessels, respectively. There is a pressure difference caused by the different front pump pressure P_f and rear pump pressure P_b, as shown in **Figure 4**.

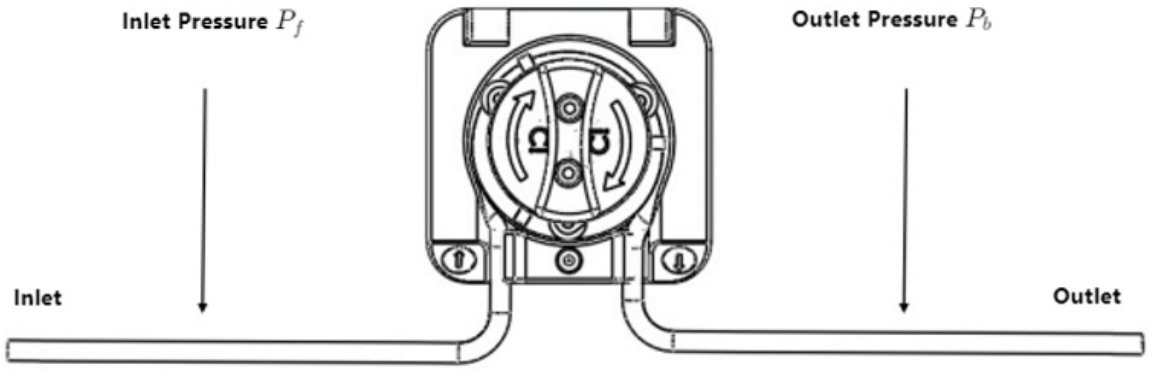


Figure 4. Pressure difference between the inlet and the outlet of the peristaltic pump.

The RCA infusion system must ensure an accurate infusion flow rate. In view of this problem, a pressure sensor is installed at the rear of the pump, and its sampling circuit is optimized to suppress zero drift, so that the pressure sensor can accurately measure the rear pump pressure. On the basis of pressure sensor signals, the flow rate of the peristaltic pump can be precisely controlled by accurately measuring the pressure difference between the front and rear of the pump and identifying its influence on flow rate.

The pressure sampling circuit adopts a fourth-order Chebyshev filter circuit (2nd order type). Its filtering response is shown in **Figure 5(a)**. The LM358 operational amplifier is used to suppress noise disturbance effectively. It has a good suppression effect on periodic interference with high smoothness, and its time

lag fully meets the design requirements. The corresponding pressure signal curve is shown in **Figure 5(b)**, showing a good linear relationship with a correlation coefficient close to 1, which means the pressure sensor can accurately measure pipeline pressure.

When the front pump pressure is equal to the rear pump pressure, the relationship between peristaltic pump speed and actual liquid flow rate is shown in Figure 5(c). In actual operation, the peristaltic pump is calibrated in the surface form as shown in Figure 5(d). The calibration curve presents the corresponding relation in **Figure 5(c)** when P =0. When the pressure difference $\mathrm{P} \neq 0$, the relation between the pump speed control signal and the flow rate is shown in Figure 5(d). It can be seen that the larger the absolute value of P , the greater the impact on actual flow rate; under the same pressure difference, the slower the control signal speed, the more obvious the impact. When $\mathrm{P} \neq 0$, the actual flow rate is jointly determined by P and the control signal.

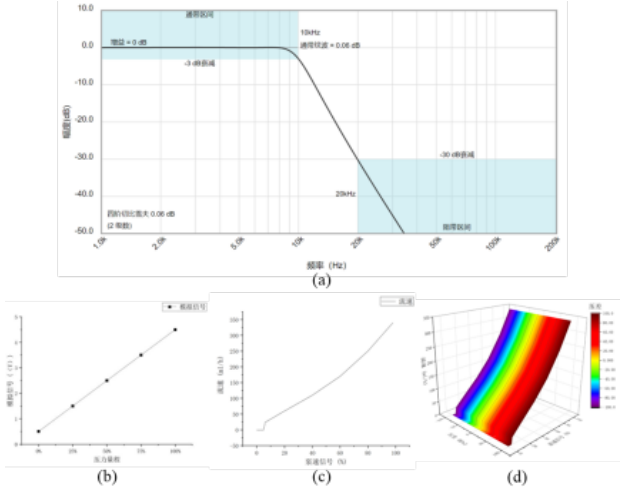


Figure 5. Results of air pressure acquisition. (a) Signal filtering; (b) Schematic diagram of pressure signal and corresponding output analog voltage; (c) Relationship between pump speed and liquid flow rate without pressure difference; (d) Relationship between pump speed and liquid flow rate with pressure difference

Therefore, the corresponding calibration relationship between the expected infusion flow rate of the RCA infusion system and peristaltic pump speed is a surface, as shown in **Figure 5(d)**, rather than a straight line or ordinary curve. A dual-fitting flow control algorithm is designed for this situation:

$$R_{flow} = f_1(sig) + f_2(\Delta P) \tag{5}$$

Where R_{flow} is the motor control output of the peristaltic pump; $f_1(\mathrm{sig})$ is the fitted value according to the calibration curve under the ideal condition of $\triangle \mathrm{P}=0$, which is also the expected input of the ADRC algorithm; $f_2(\triangle \mathrm{P})$ Is the flow compensation corresponding to $\triangle \mathrm{P} \neq 0$. $f_2(\triangle \mathrm{P})$ can be obtained by piecewise calibration combined with the least squares method.

4. Experimental results and analysis

Flow rate tests under various environments were completed in the laboratory of Shanghai Institute of Medical Device Testing, and the results are shown in **Table 1**.

Table 1. Relationship between compensated flow rate and peristaltic pump control signal under different pressure differences

Pressure difference ΔP (kPa)	Set flow rate (mL/h)	Control signal under ΔP = 0 (%)	Actual control signal (%)	Actual flow rate (mL/h)	Difference from ΔP = 0 (mL/h)
0	72.5	25	25	72.3	—
25	72.5	25	25.48	72.4	0.1
50	72.5	25	25.89	72.6	0.3
75	72.5	25	26.16	72.6	0.3
0	139.8	50	50	140.0	—
25	139.8	50	50.54	140.6	0.6
50	139.8	50	51.00	140.5	0.5
75	139.8	50	51.39	140.5	0.5
0	230.2	75	75	230.2	—
25	230.2	75	75.62	229.6	-0.6
50	230.2	75	76.04	229.5	-0.7
75	230.2	76.33	76.33	230.4	0.2

It can be seen from **Table 1** that under different pressure differences (), the compensated flow rate has little difference from that under , within the allowable error range of equipment technical requirements.

A tertiary hospital built an actual application environment by connecting the RCA infusion system with CRRT and other equipment for a series of tests, as shown in **Figure 6**. The three-necked flask at the bottom simulates the artificial pressure environment equipped with a pressure gauge, adopting a simulated test instead of a direct human test. The simulation results show that the RCA infusion system can work normally with infusion speed fully meeting equipment specifications and actual treatment requirements under pressure differences before and after the peristaltic pump.



Figure 6. Simulation test in a hospital treatment environment.

5. Conclusion and prospect

Aiming at the problems of the RCA infusion system in practical medical applications, this paper designs a peristaltic pump flow rate control system by adopting linear ADRC. To ensure accurate liquid infusion under a specific pressure difference and overcome regular errors caused by the external environment, the surface

calibration method is adopted for flow compensation. Experimental results and actual hospital environment tests verify that the developed RCA infusion system can effectively improve flow rate accuracy, meet clinical requirements, and facilitate the clinical application of RCA technology.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Mehta R, McDonald B, Aguilar M, et al., 1990, Regional Citrate Anticoagulation for Continuous Arteriovenous Hemodialysis in Critically Ill Patients. Kidney International, 38: 976–981.

[2] Oudemans-Van S, Bosman R, Koopmans M, et al., 2009, Citrate Anticoagulation for Continuous Venovenous Hemofiltration. Critical Care Medicine, 37: 545–552.

[3] Khwaja A, 2012, KDIGO Clinical Practice Guidelines for Acute Kidney Injury. Nephron Clinical Practice, 120: c179–c184.

[4] Zheng Y, Xu Z, Zhu Q, et al., 2013, Citrate Pharmacokinetics in Critically Ill Patients with Acute Kidney Injury. PLoS One, 8(6): e65992.

[5] Han J, 1998, Active Disturbance Rejection Control and Its Application. Control and Decision, 13(1): 19–23.

[6] Han J, Zhang W, 1999, Active Disturbance Rejection Control for Large Time-Delay Systems. Control and Decision, 14(4): 354–358.

[7] Gong D, Ji D, Xie H, et al., 2001, The Effects of Dialysate and Ultrafiltration Flow Rate on Solute Clearance During Continuous Renal Replacement Therapy. Zhonghua Nei Ke Za Zhi, 40: 183–186.

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A Retrospective Study on Perioperative Nursing with ERAS Protocol for Postoperative Rehabilitation after Unilateral Biportal Endoscopic Treatment of Lumbar Degenerative Diseases

Chang'e Kuang[1,3], Wei Ye[2,3], Ensi Zhao[1,3], Ji Wang[1,3], Dongfen Lu[1,3]*, Kebing Chen[1,3]*

[1]Department of Spine Surgery, The Sixth Affiliated Hospital, Sun Yat-sen University, Guangzhou 510000, Guangdong, China
[2]Department of Joint Surgery & Sports Medicine, The Sixth Affiliated Hospital, Sun Yat-sen University, Guangzhou 510000, Guangdong, China
[3]Biomedical Innovation Center, The Sixth Affiliated Hospital, Sun Yat-sen University, Guangzhou 510000, Guangdong, China

***Corresponding authors:** Kebing Chen, chkbing@mail.sysu.edu.cn; Dongfen Lu, ludf@mail.sysu.edu.cn

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Abstract: *Objective*: To explore the clinical efficacy of perioperative nursing based on Enhanced Recovery After Surgery (ERAS) in patients receiving unilateral biportal endoscopy (UBE) for lumbar degenerative diseases (LDD), and to provide objective evidence for optimizing postoperative rehabilitation regimens. *Methods*: A total of 95 patients diagnosed with LDD who underwent UBE surgery from February 2024 to June 2025 were retrospectively enrolled and categorized into a conventional rehabilitation group (n = 49) and an ERAS group (n = 46) according to different postoperative rehabilitation protocols. The conventional group received routine traditional perioperative nursing, whereas the ERAS group was managed with a comprehensive perioperative regimen consisting of preoperative health education, preoperative nutritional support, preemptive analgesia, intraoperative humanistic care, and graded postoperative rehabilitation training. Baseline demographic data, health economic indicators including length of hospital stay and total hospitalization expense, as well as postoperative outcome indexes involving VAS, BI, and ODI scores, were statistically compared between the two cohorts. *Results*: No statistically significant intergroup differences were detected in baseline data ($p > 0.05$). From the perspective of health economics, the ERAS group yielded remarkably shorter hospital stay (7.89 ± 0.24 days vs 8.92 ± 0.41 days) and lower total hospitalization cost (32402 ± 592.1 CNY vs 35166 ± 1128 CNY), with statistically significant discrepancies ($p = 0.036$). In terms of postoperative functional recovery, the ERAS group achieved markedly lower VAS scores at postoperative day 5 and day 7 (1.70 ± 0.08, 0.44 ± 0.11 versus 2.14 ± 0.09, 0.82 ± 0.11, $p < 0.05$); the Barthel Index (BI) at postoperative day 2 was statistically higher in the ERAS group (65.87 ± 2.14 vs 58.57 ± 2.41, $p = 0.027$); meanwhile, the Oswestry Disability Index (ODI) measured at 3 months after surgery was significantly reduced in the ERAS cohort (21.43 ± 0.93 vs 25.62 ± 1.05, $p = 0.004$). *Conclusion*: The application of

ERAS-based standardized perioperative nursing in UBE surgery for LDD can effectively shorten hospitalization duration, cut down medical expenditure, accelerate postoperative pain relief, improve recovery of activities of daily living, and facilitate the rehabilitation of lumbar spinal function, which delivers prominent clinical and economic benefits and deserves widespread clinical promotion.

Keywords: Unilateral biportal endoscopy; Lumbar degenerative diseases; Enhanced recovery after surgery; Clinical efficacy; Perioperative nursing

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1. Introduction

Lumbar degenerative diseases (LDD) refer to a spectrum of prevalent clinical disorders pathologically characterized by intervertebral disc degeneration, intervertebral space stenosis, osteoproliferation, and ligamentum flavum hypertrophy, predominantly including lumbar disc herniation, lumbar spinal stenosis, and lumbar spondylolisthesis. Clinically affected patients commonly complain of lumbago, radiating lower-extremity pain, numbness, muscular weakness, and intermittent claudication, which severely compromise patients' quality of life [1]. Epidemiological statistics reveal that approximately 103 million individuals worldwide suffer from symptomatic lumbar spinal stenosis, while the lifetime prevalence of lumbar disc herniation reaches up to 23.9% [2]. Surgical intervention serves as the definitive therapeutic option for patients refractory to conservative management, with core operative goals focusing on decompression of compressed nerve roots, restoration of spinal biomechanical stability, and remission of associated clinical symptoms [3].

Unilateral Biportal Endoscopy (UBE) establishes an independent observation portal alongside a separate working access. Equipped with magnified endoscopic vision and flexible operative space, this minimally invasive technique enables precise neural decompression with minimal parenchymal injury and has been increasingly adopted for the surgical management of various lumbar degenerative pathologies [4]. Danish scholar Kehlet originally put forward the ERAS concept in the 1990s, which aims to mitigate surgical stress response and expedite postoperative rehabilitation via multidisciplinary and multimodal perioperative optimization protocols. Though relatively late to be introduced into spinal surgery, ERAS has gained rapid developmental momentum and evolved into a core optimization strategy for perioperative spinal care in recent years [5].

In this study, clinical data of LDD patients receiving UBE operation at the Department of Spine Surgery of the Sixth Affiliated Hospital of Sun Yat-sen University were retrospectively analyzed to make a cross-sectional comparison of postoperative rehabilitation, clinical efficacy, and health economic outcomes between ERAS-guided nursing and conventional nursing regimens, so as to provide empirical reference for individualized clinical protocol formulation.

2. Materials and methods

2.1. General clinical data

Ninety-five LLD patients who received UBE surgery between February 2024 and June 2025 were retrospectively recruited and split into a conventional rehabilitation group (n = 49) and an ERAS group (n =

46) based on divergent postoperative nursing schemes.

2.1.1. Inclusion criteria

(1) Confirmatory diagnosis of lumbar disc herniation, lumbar spinal stenosis, or other LDD via CT and MRI imaging, with clinical manifestations consistent with radiological findings;
(2) Progressive symptom aggravation after more than six months of ineffective conservative treatments, including pharmacotherapy, physical manipulation, and epidural injection, leading to compromised daily activities and occupational capacity;
(3) First-ever lumbar spinal surgery;
(4) Complete clinical and radiological follow-up data available for a minimum of 3 postoperative months.

2.1.2. Exclusion criteria

(1) Grade II or higher lumbar spondylolisthesis as well as severe scoliosis and kyphotic deformity;
(2) Past lumbar surgical history combined with spinal infection, spinal neoplasm, or spinal tuberculosis;
(3) Concurrent severe organic dysfunction of cardiac, pulmonary, hepatic, or renal systems incompatible with surgical tolerance;
(4) Coagulopathy or psychotic disorders interfering with surgical implementation and regular follow-up;
(5) Incomplete follow-up documentation.

2.2. Surgical protocols

A fixed experienced spinal surgical team completed all operative procedures. Preoperative systemic examinations were routinely implemented to localize pathological segments and customize individualized surgical plans in accordance with standardized operative specifications documented by Ouyang et al [5].

(1) Anesthesia and positioning

General anesthesia was administered, followed by prone positioning with suspended abdomen and moderate lumbar flexion to widen the interlaminar space; C-arm fluoroscopy was applied for precise segment localization.

(2) Portal establishment

Two 1-cm longitudinal incisions were made 2 cm para-spinally at the upper and lower margins of the target interlaminar space, separately allocated for observation and manipulation portals. Subcutaneous fascia was dissected sequentially, and paravertebral muscles were dilated to create a closed working cavity.

(3) Intraoperative manipulation

Continuous normal saline perfusion maintained at 50–60 cm hydrostatic pressure was adopted to keep the surgical field clear. A 30° endoscope was inserted via the observation channel; radiofrequency electrocautery was used for hemostasis and soft tissue release, followed by high-speed burr and rongeur laminotomy and flavum ligament resection to expose the dural sac and exiting nerve roots fully. For disc herniation cases, nerve retractors gently mobilized neural tissues for subsequent nucleus pulposus enucleation; for spinal stenosis patients, a unilateral approach, bilateral decompression was accomplished to ensure thorough clearance of lateral recess and central canal stenosis.

(4) Postoperative management

Meticulous hemostasis was performed under endoscopic visualization, followed by indwelling drainage

tube implantation and layered wound closure covered with a sterile compressive dressing.

2.3. Nursing interventions

2.3.1. Control group (conventional perioperative nursing)

Patients were instructed to fast from 22:00 and prohibit oral intake after midnight on the preoperative day [6]. Standard pre-operative health education was delivered by in-charge nurses regarding disease pathogenesis, operative principles, postoperative routine rehabilitation, and relevant precautions; psychological counseling was provided for anxious patients. Vital signs were continuously monitored, and normothermia was maintained intraoperatively. Postoperative interventions included timely dressing change upon bleeding infiltration, dietary guidance, specification of waist orthosis wearing period, early functional training arrangement, and scheduled outpatient follow-up.

2.3.2. ERAS group (standardized ERAS multimodal perioperative nursing)

(1) Preoperative health education

Multimedia materials, including PPT and educational videos, were utilized to systematically elaborate disease etiology, surgical workflow, and full-course perioperative precautions; interactive Q&A sessions and targeted psychological intervention alleviated patients' preoperative dread and improved therapeutic compliance.

(2) Preoperative preparation

Personalized high-calorie, digestible dietary plans were formulated in line with individual eating habits. Consistent with ERAS criteria, patients with intact gastrointestinal function fasted solid food for 6 hours preoperatively and were permitted clear liquid intake up to 2 hours before anesthesia; carbohydrate-containing beverages were recommended 2 hours ahead for non-diabetic subjects [7]. Preemptive analgesia was initiated 8–12 hours prior to surgery. Nursing staff conducted proactive communication for emotionally distressed patients to emphasize the positive impact of mental stability on surgical success and subsequent recovery; warm towel skin cleaning was performed before ward transfer to minimize perioperative infection risks.

(3) Intraoperative humanistic management

Skin disinfection was strictly ensured before puncture under local anesthesia induction. Soothing background music was played throughout surgery alongside continuous real-time monitoring of body temperature, respiration, ECG, and blood pressure; casual chatting was adopted to distract nervous patients and ease psychological stress.

(4) Postoperative graded functional rehabilitation training

Within 12 h post-surgery: Alternating straight leg raise training, 5–10 min per session, four sessions daily with progressive elevation range. Postoperative Days 1–3: Wall-standing exercise requiring shoulder, hip, and heel tight against the wall for 5 min per time, five sets per day. One week after operation: Progressive core strengthening training including small swallow exercise (prone head-limb lifting, 10–15 repetitions per group, five groups daily), five-point supine bridging (supported by bilateral elbows, feet and occiput, hold for 3–5 s per lift, 10–15 times per set, three sets daily) and three-point bridging with crossed upper limbs (supported by feet and vertex, identical grouping specifications). Two weeks postoperatively: Gradual introduction of lumbar flexion training (supine knee hugging for maximum spinal flexion, 10

times per group, twice daily), prone push-up extension training, and torso rotation workout with alternating unilateral upper limb twist, two sets apiece every day.

(5) Discharge-directed nursing

Spinal specialized nurses collaborated with attending physicians to assess lumbar functional recovery and draft personalized home rehabilitation regimens; patients were required to wear lumbar orthosis continuously for six weeks and refrain from heavy manual labor for three months. A dedicated WeChat rehabilitation group was established for regular health education delivered by senior nurses and online real-time coaching administered by attending surgeons; compliant recovered patients were invited to share workout experience within the group to boost overall adherence, with a total follow-up duration of three months.

2.4. Outcome observation indicators

(1) Baseline data

Age, gender, stature, body weight, and BMI value.

(2) Health-economic indexes

Total length of hospital stays (from operative day to discharge), overall hospitalization expenditure.

(3) Postoperative functional scoring

VAS (Visual Analog Scale): assessed at 1 day before operation, 1 day, 3 days, 5 days, and 7 days after operation (0 = pain-free, 10 = unbearable severe pain); BI (Barthel Index): measured at 1 day before operation, 1 day, and 2 days after operation (full score = 100, higher score denotes superior self-care ability); ODI (Oswestry Disability Index): evaluated at 1 day before operation, 1 week, 1 month, and 3 months after operation (higher score indicates aggravated lumbar dysfunction).

2.5. Statistical analysis

All statistical analyses were processed via SPSS 22.0 software. Measurement data were expressed as mean ± standard deviation ($\overline{x} \pm s$); an independent samples *t*-test was adopted for intergroup comparison, while a Chi-square test was applied for enumeration data; $p < 0.05$ was defined as a statistically significant difference.

3. Results

3.1. Baseline characteristics comparison

Conventional group: 19 males, 30 females, aged 31–80 years, with an average age of 57.98 ± 2.11 years, a mean height of 160.6 ± 1.08 cm, an average body weight of 63.89 ± 1.69 kg, and a BMI ranging from 27.56 to 55.23 kg/m^2, with a mean of 39.71 ± 0.94 kg/m^2.

ERAS group: 20 males, 26 females, aged 13–83 years, with an average age of 56.00 ± 2.08 years, a mean height of 162.7 ± 1.24 cm, an average body weight of 63.20 ± 1.89 kg, and a BMI ranging from 27.74 to 58.14 kg/m^2, with a mean of 38.67 ± 0.98 kg/m^2.

No statistically significant intergroup discrepancies existed in age, gender, height, body weight, and BMI ($p > 0.05$), confirming comparable baseline conditions (**Table 1**).

Table 1. Comparison of baseline profiles between the two groups

Index		Conventional group (n = 49)	ERAS group (n = 46)	t/χ^2	*p*-value
Age(y)		57.98 ± 2.11	56.00 ± 2.08	0.67	0.507
Gender	Male	19	20	0.22	0.642
	Female	30	26	-	-
Height(cm)		160.6 ± 1.08	162.7 ± 1.24	1.30	0.197
Weight(kg)		63.89 ± 1.69	63.20 ± 1.89	0.27	0.788
BMI (kg/m^2)		39.71 ± 0.94	38.67 ± 0.98	0.76	0.447

3.2. Health-economic outcome comparison

The average length of hospital stay was 8.92 ± 0.41 days in the conventional group versus 7.89 ± 0.24 days in the ERAS group (t = 2.13, p = 0.036); total hospitalization cost stood at 35166 ± 1128 CNY vs 32402 ± 592.1 CNY, respectively (t = 2.13, p = 0.036). Both indicators achieved statistically significant superiority in the ERAS cohort (**Table 2**).

Table 2. Comparison of health-economic indicators

Index	Conventional group	ERAS group	*t*-value	*p*-value
Hospitalization(d)	8.92 ± 0.41	7.89 ± 0.24	2.13	0.036
Total cost (CNY)	35166 ± 1128	32402 ± 592.1	2.13	0.036

3.3. Postoperative functional scores comparison

On the day before surgery, the VAS scores were 3.41 ± 0.10 in the conventional rehabilitation group and 3.37 ± 0.10 in the ERAS group, with no statistically significant difference between the two groups (t = 0.27, p = 0.787), indicating comparable preoperative pain levels. On postoperative day 1, the VAS scores were 4.61 ± 0.08 in the conventional rehabilitation group and 4.61 ± 0.08 in the ERAS group, again showing no statistical difference (t = 0.03, p = 0.974). On postoperative day 3, the scores were 4.33 ± 0.11 in the conventional rehabilitation group and 4.07 ± 0.11 in the ERAS group, with no significant difference (t = 1.62, p = 0.109). On postoperative day 5, the scores were 2.14 ± 0.09 in the conventional rehabilitation group and 1.70 ± 0.08 in the ERAS group, revealing a statistically significant difference (t = 3.85, p < 0.0001), with lower VAS scores in the ERAS group. On postoperative day 7, the scores were 0.82 ± 0.11 in the conventional rehabilitation group and 0.44 ± 0.11 in the ERAS group, also showing a significant difference (t = 2.34, p < 0.021), with the ERAS group having lower VAS scores (**Table 3**).

Table 3. Serial VAS score comparison

Timing	Conventional group	ERAS group	*t*-value	*p*-value
Pre-op D1	3.41 ± 0.10	3.37 ± 0.10	0.27	0.787
Post-op D1	4.61 ± 0.08	4.61 ± 0.08	0.03	0.974
Post-op D3	4.33 ± 0.11	4.07 ± 0.11	1.62	0.109
Post-op D5	2.14 ± 0.09	1.70 ± 0.08	3.85	< 0.001
Post-op D7	0.82 ± 0.11	0.44 ± 0.11	2.34	0.021

On the day before surgery, the BI score of the conventional rehabilitation group was 93.57 ± 2.06 points, while that of the ERAS group was 95.43 ± 1.65 points. There was no statistically significant difference

between the two groups (t = 0.70, p = 0.485). It can be concluded that the preoperative daily activity ability of the patients in both groups was the same, and they were comparable. On the first day after the surgery, the BI score of the conventional rehabilitation group was 39.39 ± 1.86 points, and that of the ERAS group was 40.76 ± 1.62 points. There was no statistically significant difference between the two groups (t = 0.55, p = 0.581). On the second day after the surgery, the BI score of the conventional rehabilitation group was 58.57 ± 2.41 points, and that of the ERAS group was 65.87 ± 2.14 points. There was a statistically significant difference between the two groups (t = 2.25, p = 0.027), and the BI score of the ERAS group was higher than that of the conventional rehabilitation group (**Table 4**).

Table 4. Serial BI score comparison

Timing	Conventional group	ERAS group	*t*-value	*p*-value
Pre-op D1	93.57 ± 2.06	95.43 ± 1.65	0.70	0.485
Post-op D1	39.39 ± 1.86	40.76 ± 1.62	0.55	0.581
Post-op D2	58.57 ± 2.41	65.87 ± 2.14	2.25	0.027

On the day before the operation, the ODI score of the conventional rehabilitation group was 19.15 ± 0.93 points, while that of the ERAS group was 16.78 ± 1.06 points. There was no statistically significant difference between the two groups (t = 1.68, p = 0.096), which suggests that the preoperative functional impairment degree of the patients in both groups was the same and they were comparable. The ODI score on the first week after the operation was 36.74 ± 1.03 points for the conventional rehabilitation group and 35.32 ± 1.47 points for the ERAS group. There was no statistically significant difference between the two groups (t = 0.80, p = 0.426). The ODI score on the first month after the operation was 32.07 ± 0.87 points for the conventional rehabilitation group and 30.44 ± 0.96 points for the ERAS group. There was no statistically significant difference between the two groups (t = 1.26, p = 0.212). The ODI score on the third month after the operation was 25.62 ± 1.05 points for the conventional rehabilitation group and 21.43 ± 0.93 points for the ERAS group. There was a statistically significant difference between the two groups (t = 2.97, p = 0.004), and the ODI score of the ERAS group was lower than that of the conventional rehabilitation group (**Table 5**).

Table 5. Serial ODI score comparison

Timing	Conventional group	ERAS group	*t*-value	*p*-value
Pre-op D1	19.15 ± 0.93	16.78 ± 1.06	1.68	0.096
Post-op W1	36.74 ± 1.03	35.32 ± 1.47	0.80	0.426
Post-op M1	32.07 ± 0.87	30.44 ± 0.96	1.26	0.212
Post-op M3	25.62 ± 1.05	21.43 ± 0.93	2.97	0.004

4. Discussion

The UBE technique creates dual independent access channels for continuous saline-irrigated spinal decompression, discectomy, and interbody fusion, combining minimally invasive endoscopic merits with flexible open-surgery operability. Recent clinical literature published by Professor Zhang's research team on the *International Journal of Surgery* verified that UBE application for elderly patients with lumbar spinal stenosis combined with degenerative scoliosis effectively reduces intraoperative hemorrhage and shortens

operative duration, reflecting organic integration between minimally invasive surgery and ERAS philosophy [8]. Existing meta-analyses confirm that endoscopic minimally invasive spinal procedures serve as a core constituent of spinal ERAS protocols, yielding superior postoperative pain relief (VAS) and functional recovery (ODI) versus traditional open operations; UBE itself possesses inherent advantages facilitating accelerated postoperative rehabilitation [9]. Further implementation of standardized multimodal ERAS perioperative nursing upon the UBE baseline can optimize the whole rehabilitation trajectory [10]. Cumulative clinical evidence validates that ERAS bundled protocols shorten hospital stay, cut postoperative complication incidence, decrease opioid consumption, and curtail overall medical expenditure [11].

In this retrospective cohort research, ERAS nursing intervention significantly shortened hospitalization days and reduced total medical expense, elevating ward turnover rate and easing financial burden for both medical insurance funds and individual patients, which aligns with current medical insurance cost-control targets. No intergroup VAS discrepancy was identified on postoperative Day 1 and Day 3, while statistically lower pain scores emerged in the ERAS cohort starting from postoperative Day 5, demonstrating effective pain control via multimodal ERAS analgesic and nursing management to improve patients' in-hospital experience. BI indicator showed comparable outcomes on postoperative Day 1, with statistically improved daily living competence in ERAS subjects starting from Day 2, suggesting early functional benefit of ERAS rehabilitation protocol. Although short-term postoperative ODI revealed no prominent between-group difference, significant long-term functional improvement manifested at three-month follow-up, which proves ERAS nursing contributes to sustained reduction of chronic lumbar dysfunction after spinal surgery.

Collectively, UBE minimally invasive operation intrinsically conforms to the core tenets of the ERAS concept; systematic ERAS perioperative nursing further maximizes postoperative rehabilitation efficacy and complies with cost-saving medical insurance optimization goals. Nevertheless, domestic and international research concerning combined UBE-ERAS application remains in an exploratory stage with inconsistent implementation details across different clinical centers. Further controlled clinical trials are essential to standardize perioperative ERAS pathways and accelerate patient recovery.

Limitations of this study include inherent selection bias originating from retrospective design and relatively limited sample volume; long-term safety and efficacy require extended follow-up observation. Subgroup stratification by pathological segment quantity (single/multi-level lesion) and patient demographics (elderly, obese population) was not performed. Prospective large-sample multicenter research is warranted to supplement relevant clinical evidence in future investigations.

5. Conclusion

The application of ERAS-based standardized perioperative nursing in UBE surgery for lumbar degenerative disease (LDD) effectively shortens hospital stay, reduces medical costs, accelerates pain relief, improves daily living activities, and promotes lumbar functional recovery. These benefits demonstrate significant clinical and economic value, warranting broader adoption in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Ouyang J, Yang Q, Chen L, et al., 2024, A Comparative Analysis of Unilateral Biportal Endoscopic and Open Laminectomy in Multilevel Lumbar Stenosis. Frontiers in Neurology, 15: 1409088.

[2] Yu X, Yue H, Wei H, et al., 2023, Comparative Study of Unilateral Biportal Endoscopic and Traditional Open Surgery in the Treatment of Lumbar Disc Herniation. Alternative Therapies in Health and Medicine, 29(5): 370–374.

[3] Peng Y, Fan Z, Wang Q, et al., 2023, Comparison of the Total and Hidden Blood Loss in Patients Undergoing Single-Level Open and Unilateral Biportal Endoscopic Transforaminal Lumbar Interbody Fusion. BMC Musculoskeletal Disorders, 24: 295.

[4] Ma T, Li J, Geng Y, et al., 2024, Unilateral Biportal Endoscopic vs. Open Surgery in the Treatment of Young Obese Patients' Lumbar Degenerative Diseases: A Retrospective Study. Frontiers in Surgery, 11: 1467768.

[5] Sescu D, Dahiya D, Scaramuzzo L, et al., 2025, Optimizing Postoperative Spine Outcomes: An Umbrella Review of Enhanced Recovery After Spinal Surgery (ERASS). British Journal of Anesthesia, 135(6): 1663–1683.

[6] Zhu Y, Lang Y, Wang Y, 2023, Influence of 5A Refined Nursing on Postoperative Rehabilitation of Lumbar Disc Herniation Patients. Chinese Journal of Pain Medicine, 29(08): 632–635.

[7] Zou Y, Xie H, Chen L, et al., 2021, Application of ERAS-Based Preoperative Fasting Guideline in Orthopedic Consecutive Operations. Heilongjiang Medical Journal, 45(24): 2587–2588 + 2591.

[8] Yang H, Cheng F, Hai Y, et al., 2024, Unilateral Biportal Endo-LIF Facilitates the Recovery of an Elderly Patient with Lumbar Stenosis with Degenerative Spinal Scoliosis. International Journal of Surgery, 110(7):4422–4424.

[9] Yang H, Cheng F, Hai Y, et al., 2023, Unilateral Biportal Endoscopic Lumbar Interbody Fusion Enhanced the Recovery of Patients with Lumbar Degenerative Disease Compared with Conventional Posterior Procedures: A Systematic Review and Meta-Analysis. Frontiers in Neurology, 13: 1089981.

[10] Li W, Liu X, Xu L, et al., 2025, Evaluation of the Value of Enhanced Recovery After Surgery in Postoperative Recovery Following Unilateral Biportal Endoscopic Lumbar Interbody Fusion. International Journal of Clinical and Experimental Medicine, 17(11): 9109–9119.

[11] Fujii T, Kumar R, Lipson P, et al., 2025, Enhanced Recovery After Surgery Protocol in Patients with Adult Spinal Deformity: A Systematic Review and Meta-Analysis. Global Spine Journal, 15(7): 3426–3438.

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Effects of Respiratory Function Training on Pulmonary Function and Recurrence of Wheezing Diseases in Children

Shilan Chen[1,2], Rong Feng[2]*, Yan Chen[1,2], Yuehong Li[1,2]

[1]The Affiliated Maternity and Child Health Hospital of Yangzhou University, Yancheng 224000, Jiangsu, China
[2]School of Nursing, Jiangsu Medical College, Yancheng 224000, Jiangsu, China

Author to whom correspondence should be addressed.

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Abstract: *Objective*: To explore the clinical application effects of respiratory function training on children with wheezing diseases. *Methods*: A total of 96 children with wheezing diseases admitted to Yancheng Maternity and Child Healthcare Hospital from January 2025 to March 2026 were enrolled and divided into a control group and an observation group by random number table, with 48 cases in each group. The control group received conventional treatment and routine nursing. On the basis of conventional interventions, the observation group was given additional respiratory function training for a total of 3 months. Pulmonary function indicators, wheezing recurrence rate, readmission rate, and nursing satisfaction were compared between the two groups before and after intervention. *Results*: After intervention, the levels of FEV1, FVC, and PEF in the observation group were superior to those of the control group. The wheezing recurrence rate was lower, while the nursing satisfaction was higher in the observation group, with all differences being statistically significant. *Conclusion*: Respiratory function training can effectively improve pulmonary function, reduce wheezing recurrence, and raise nursing satisfaction among children with wheezing diseases. It is worthy of clinical promotion.

Keywords: Respiratory function training; Childhood wheezing diseases; Pulmonary function

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1. Introduction

Childhood wheezing diseases are common respiratory disorders in pediatric clinics, mainly manifested as recurrent wheezing, cough, tachypnea, and dyspnea. Such diseases are usually induced by respiratory tract infection, allergy, airway hyperresponsiveness, and other factors. Children have relatively narrow respiratory lumens, delicate airway mucosa, and abundant secretions. Their pulmonary function and immune system are not fully developed, so they are more prone to airway obstruction and ventilatory dysfunction when

affected by infection or external stimuli. Recurrent wheezing hinders the recovery of pulmonary function and impairs children's quality of life. It also increases the risks of emergency visits, hospital readmission, and subsequent asthma development, bringing heavy psychological and economic burdens to children's families [1–3]. Therefore, while controlling acute symptoms, promoting the recovery of pulmonary function, and reducing recurrence have become key issues in the nursing intervention of childhood wheezing diseases. At present, the treatment of childhood wheezing diseases mainly relies on drug therapies such as anti-infection, anti-wheezing, antitussive, expectorant, and atomization inhalation, combined with routine nursing. These interventions can relieve clinical symptoms to a certain extent, but have limitations in improving respiratory muscle function, facilitating the discharge of airway secretions, raising pulmonary ventilation efficiency, and preventing recurrent attacks. In recent years, the concept of pulmonary rehabilitation has been gradually applied to the nursing of pediatric respiratory diseases. As a simple, safe, and non-pharmacological rehabilitation intervention, respiratory function training has attracted extensive clinical attention.

2. Materials and methods

2.1. General data

A total of 96 children diagnosed with wheezing diseases and admitted to the pediatric department of Yancheng Maternity and Child Healthcare Hospital from January 2025 to March 2026 were selected as research subjects. They were divided into a control group and an observation group using the random number table method, with 48 cases in each group.

2.1.1. Inclusion criteria

Complied with the diagnostic criteria for childhood wheezing diseases; aged 4 to 10 years old; in stable condition and capable of cooperating with pulmonary function tests and respiratory function training; guardians fully understood the research and signed informed consent forms.

2.1.2. Exclusion criteria

Combined with congenital heart disease, foreign bodies in the airway, laryngomalacia, mediastinal tumors and other diseases affecting respiratory function; complicated with severe neurological diseases, mental disorders or cognitive impairment and unable to cooperate with training; conditions aggravated during treatment requiring transfer to intensive care unit; incomplete clinical data, cases who withdrew or were lost to follow-up; poor compliance and failure to complete training as required. The hospital ethics committee approved this study, and all procedures followed the principles of informed consent, voluntary participation, privacy protection, and harmlessness.

2.2. Intervention methods

2.2.1. Control group

The control group received conventional treatment and routine nursing. Conventional treatments, including anti-infection, anti-wheezing, antitussive, expectorant, atomization inhalation, and oxygen therapy, were formulated by attending physicians according to children's specific conditions [4].

Routine nursing contents:

(1) Condition monitoring

Closely observed children's body temperature, heart rate, respiratory rate, blood oxygen saturation, cough, wheezing, and lung signs, and timely reporting to physicians once aggravated tachypnea or decreased blood oxygen was found.

(2) Respiratory tract nursing

Guided children to adopt semi-recumbent or comfortable positions to keep the respiratory tract unobstructed. Turned over and assisted with back patting for children with excessive sputum; performed sputum aspiration according to medical orders when necessary.

(3) Atomization and medication nursing

Assisted children to receive atomization inhalation therapy, informed guardians of drug effects, precautions, and adverse reaction observation points to improve treatment compliance.

(4) Environmental and dietary nursing

Kept ward well-ventilated with the temperature maintained at 22–24 ℃ and relative humidity at 55–60%. Guided children to take light, digestible, high-protein, and vitamin-rich food, and encouraged proper water intake.

2.2.2. Observation group

On the basis of all interventions for the control group, the observation group received additional respiratory function training. Uniformly trained registered nurses guided the training. Before training, nurses assessed children's mental state, respiratory rate, blood oxygen saturation, degree of wheezing and tolerance, and formulated graded training intensity according to individual conditions [5]. Training was suspended immediately, and corresponding interventions were given if children developed obvious tachypnea, chest tightness, dizziness, pale complexion, or decreased blood oxygen saturation during training.

(1) Diaphragmatic breathing training

Children took sitting, semi-recumbent, or supine knee-bent positions and relaxed the whole body. One hand was placed on the chest and the other on the abdomen. Children were instructed to inhale slowly through the nose to bulge the abdomen, hold breath for 2 to 3 seconds, then exhale slowly through the mouth to retract the abdomen. The expiration duration was 2 to 3 times longer than inhalation, and the respiratory rate was controlled at 8 to 10 breaths per minute. Each session lasted 5 to 10 minutes, 2 to 3 times a day.

(2) Balloon-blowing training

Selected balloons of the proper size and resistance. Children took a deep breath through the nose first, then pouted to blow the balloon slowly. Holding breath and excessive force or hyperventilation were avoided. The number of blows was increased gradually according to the children's age and tolerance. Each session lasted 3 to 5 minutes, 5 to 10 times a day.

2.2.3. Graded training management

Before training, nurses assessed children's body temperature, respiratory rate, heart rate, blood oxygen saturation, wheezing degree, and mental state, and divided them into low-risk, medium-risk, and high-risk groups:

(1) Low-risk children

Stable condition, blood oxygen saturation (SpO_2) ≥ 95%. They could complete full training, including diaphragmatic breathing, pursed-lip breathing, balloon blowing, and effective coughing.

(2) Medium-risk children

Mild to moderate tachypnea, SpO_2 ranging from 90% to 94%. Training duration and movement range were shortened appropriately. Training mainly focused on diaphragmatic breathing, pursed-lip breathing, and mild sputum excretion. Blood oxygen saturation was monitored before and after training.

(3) High-risk children

Obvious tachypnea or unstable condition with $SpO_2 < 90\%$. Active respiratory training was suspended temporarily. Interventions focused on oxygen therapy, condition observation, and airway patency maintenance. Low-intensity training was resumed gradually after conditions became stable.

All children received continuous intervention for 3 months. On-site guidance was provided during hospitalization. Follow-up was conducted via phone or WeChat after discharge at least once a week to supervise training completion, monitor symptom changes, and record recurrence.

2.3. Observation indicators

2.3.1. Pulmonary function indicators

Pulmonary function tests were performed before intervention and 3 months after treatment, respectively. Test indicators included forced expiratory volume in one second (FEV1), forced vital capacity (FVC), peak expiratory flow (PEF), and FEV1/FVC ratio. All tests were completed by the same trained examiner with unified procedures, and children were required to stay calm without a severe cough or obvious tachypnea before testing.

2.3.2. Clinical symptom indicators

Recorded the relief time of wheezing and cough, disappearance time of lung wheezing rales, and length of hospital stay. Wheezing relief time referred to the time when wheezing was obviously alleviated without additional anti-wheezing treatment. Cough relief time was defined as the time when cough frequency decreased, and nocturnal cough was relieved. The disappearance of lung wheezing rales was judged by auscultation of physicians or nurses [6]. All children were followed up for 3 months after intervention to record the incidence of wheezing recurrence, emergency visits, and readmission. Wheezing recurrence was defined as the reappearance of obvious wheezing requiring anti-wheezing drugs or medical treatment during follow-up.

2.4. Statistical methods

SPSS 26.0 statistical software was used for data analysis [7]. Measurement data conforming to normal distribution were expressed as mean ± standard deviation ($\bar{x} \pm s$). An independent-samples *t*-test was ad opted for inter-group comparison, and a paired t-test for intra-group comparison before and after interve ntion. Non-normal distributed data were analyzed by the Mann-Whitney U test [8]. Enumeration data w ere presented as cases and percentages, and compared by the Chi-square test or Fisher's exact test. Repea ted measures analysis of variance was applied for a comprehensive comparison of pulmonary function indic ators before, after, and between groups. A p value less than 0.05 indicated a statistically significant diffe rence.

3. Results

3.1. Comparison of general data between two groups

There were no significant differences in gender, age, disease course, wheezing degree, and history of allergy between the control group and the observation group ($p > 0.05$), indicating balanced baseline data and good comparability. See **Table 1**.

Table 1. Comparison of general data between the two groups

Item	Control group (n = 48)	Observation group (n = 48)	t/χ^2 value	p value
Male/Female (cases)	27/21	25/23	0.168	0.682
Age (years)	6.84±1.42	6.7±1.36	0.458	0.648
Disease course (days)	3.58±0.91	3.46±0.87	0.660	0.511
Mild/Moderate wheezing (cases)	30/18	32/16	0.177	0.674
History of allergy (cases)	14	16	0.190	0.663

3.2. Comparison of pulmonary function indicators before and after intervention

Before intervention, FEV1, FVC, PEF, and FEV1/FVC showed no significant differences between the two groups ($p > 0.05$). After intervention, pulmonary function indicators of both groups were improved, and the observation group had higher FEV1, FVC, PEF, and FEV1/FVC than the control group, with statistically significant differences ($p < 0.05$). In the observation group, post-intervention FEV1 was (1.34±0.29) L, FVC was (1.86±0.36) L, PEF was (4.53±0.91) L/s, and FEV1/FVC was (75.91±6.37) %, which were all superior to those of the control (FEV1: 1.18±0.27 L; FVC: 1.67±0.34 L; PEF: 3.86±0.88 L/s; FEV1/FVC: 71.74±6.18 %) ($p < 0.05$). See **Table 2**.

Table 2. Comparison of pulmonary function indicators before and after intervention

Indicator	Time	Control group (n = 48)	Observation group (n = 48)	t value	p value
FEV1 (L)	Before intervention	1.04±0.25	1.03±0.24	0.200	0.842
	After intervention	1.18±0.27	1.34±0.29	2.797	0.006
FVC (L)	Before intervention	1.48±0.31	1.46±0.30	0.321	0.749
	After intervention	1.67±0.34	1.86±0.36	2.657	0.009
PEF (L/s)	Before intervention	3.12±0.82	3.08±0.79	0.243	0.808
	After intervention	3.86±0.88	4.53±0.91	3.668	< 0.001
FEV1/FVC (%)	Before intervention	70.35±6.42	70.58±6.25	0.178	0.859
	After intervention	71.74±6.18	75.91±6.37	3.253	0.002

3.3. Comparison of symptom relief time

The wheezing relief time, cough relief time, disappearance time of lung wheezing rales, and hospital stay of the observation group were all shorter than those of the control group, with statistically significant differences ($p < 0.05$). The wheezing relief time of the observation group was (3.21±0.86) days, cough relief time (5.17±1.08) days, disappearance time of lung wheezing rales (3.89±0.94) days, and hospital stay (6.18±1.09) days, all shorter than the corresponding values of the control group. See **Table 3**.

Table 3. Comparison of clinical symptom relief time

Indicator	Control group (n = 48)	Observation group (n = 48)	*t* value	*p* value
Wheezing relief time (days)	4.36±1.02	3.21±0.86	5.974	< 0.001
Cough relief time (days)	6.48±1.25	5.17±1.08	5.491	< 0.001
Disappearance time of lung wheezing rales (days)	5.12±1.16	3.89±0.94	5.694	< 0.001
Hospital stays (days)	7.42±1.31	6.18±1.09	5.042	< 0.001

3.4. Comparison of recurrence and readmission rate

After 3 months of follow-up, the wheezing recurrence rate of the observation group was 12.50%, lower than 31.25% of the control group ($p < 0.05$). The emergency visit rate of the observation group was 8.33%, lower than 25.00% of the control group ($p < 0.05$). The readmission rate of the observation group was 4.17%, lower than 14.58% of the control group, with no significant difference ($p > 0.05$). See **Table 4**.

Table 4. Comparison of recurrence and readmission rate

Indicator	Control group (n = 48)	Observation group (n = 48)	χ^2 value	*p* value
Wheezing recurrence	15 (31.25)	6 (12.50)	4.937	0.028
Emergency visit	12 (25.00)	4 (8.33)	4.800	0.026
Readmission	7 (14.58)	2 (4.17)	3.139	0.076

3.5. Comparison of nursing satisfaction and training compliance

The excellent training compliance rate of the observation group was 89.58%, higher than 66.67% of the control group ($p < 0.05$). The overall nursing satisfaction of guardians in the observation group was 93.75%, higher than 79.17% of the control group ($p < 0.05$). See **Table 5**.

Table 5. Comparison of training compliance and nursing satisfaction

Indicator	Control group (n = 48)	Observation group (n = 48)	χ^2 value	*p* value
Good training compliance	32 (66.67)	43 (89.58)	7.375	0.007
Very satisfied	20 (41.67)	29 (60.42)	-	-
Satisfied	18 (37.50)	16 (33.33)	-	-
Dissatisfied	10 (20.83)	3 (6.25)	-	-
Overall satisfaction	38 (79.17)	45 (93.75)	4.360	0.037

4. Discussion

Childhood wheezing diseases are common pediatric respiratory illnesses, mainly presenting as recurrent wheezing, cough, tachypnea, and dyspnea. Children have narrow respiratory passages, abundant mucosal secretions, and underdeveloped respiratory muscles. They are prone to airway obstruction and recurrent wheezing when affected by infection, allergy, or climate change [9]. Recurrent wheezing hinders pulmonary function recovery, increases the risks of emergency treatment, readmission, and chronic progression, and brings psychological and economic burdens to families. Therefore, implementing effective pulmonary rehabilitation on the basis of conventional treatment is of great significance for relieving symptoms and

reducing recurrence.

This study showed that the two groups had comparable baseline data. After intervention, the observation group obtained better pulmonary function indicators, which proved that respiratory function training can effectively improve the pulmonary function of children with wheezing diseases. The underlying reasons are as follows: Firstly, diaphragmatic breathing expands the range of diaphragmatic movement, transforming shallow and rapid breathing into slow and deep effective breathing, and increasing alveolar ventilation to improve gas exchange. Secondly, pursed-lip breathing elevates end-expiratory airway pressure, prevents premature collapse of small airways, and facilitates the discharge of residual air in the lungs. Thirdly, balloon-blowing exercise enhances the strength and endurance of respiratory muscles and improves respiratory coordination. Relevant studies have also verified that FEV1, FVC, and PEF are core indicators for evaluating the effect of respiratory training in children, and training groups achieve better results than routine nursing groups [10].

In addition, the observation group had higher training compliance and nursing satisfaction. Respiratory function training is simple, safe, and easy to learn. Nurses' on-site guidance, regular follow-up, and feedback enhance guardians' participation and trust in nursing work [11]. Moreover, interesting training forms such as balloon blowing conform to children's psychological characteristics, reduce resistance to treatment, and increase participation willingness. Related literature also indicates that standardized respiratory training can improve children's cooperation and raise family satisfaction with nursing services [12].

5. Conclusion

In conclusion, this study demonstrates that respiratory function training, including diaphragmatic breathing and balloon-blowing exercises, can effectively improve pulmonary function indicators (FEV1, FVC, PEF), lower the short-term recurrence rate of wheezing, and increase guardians' satisfaction with nursing care in children aged 4–10 years with wheezing diseases. Given its safety, low cost, and ease of administration, this intervention offers a valuable adjunct to conventional pharmacotherapy and holds promise for reducing the long-term burden of recurrent wheezing in pediatric populations.

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References

[1] Expert Committee on Pediatric Medication of the National Health and Family Planning Commission, Respiratory Group of the Chinese Pediatric Society, Pediatric Pulmonology Committee of the Chinese Medical Doctor Association, et al., 2018, Guidelines for Rational Medication of Childhood Wheezing Diseases. Chinese Journal of

Applied Clinical Pediatrics, 33(19): 1460–1472.

[2] Chinese Medical Association, Journal of Chinese Medical Association, General Practice Branch of Chinese Medical Association, et al., 2026, Guidelines for Primary Diagnosis and Management of Bronchial Asthma (2026). Chinese Journal of General Practitioners, 25(4): 382–414.

[3] Chinese Thoracic Society, 2025, Guidelines for the Prevention and Treatment of Bronchial Asthma (2024 Edition). Chinese Journal of Tuberculosis and Respiratory Diseases, 48(3): 208–248.

[4] Fu X, Gong X, Tan J, et al., 2018, Research Progress on Influencing Factors of Childhood Wheezing Diseases. Chinese Journal of Child Health Care, 26(11): 1207–1210.

[5] Wang H, Liu C, 2019, Long-Term Prognosis and Influencing Factors of Recurrent Wheezing in Young Children. Chinese Journal of Applied Clinical Pediatrics, 34(12): 957–959.

[6] Jiang Y, Li A, Xiao Y, et al., 2024, Application of Continuous Nursing Based on EMS Model in Preschool Children with Wheezing Diseases. Journal of Shanghai Jiao Tong University, 44(2): 228–236.

[7] Jiang Y, Xu H, Chen Z, 2022, Research Progress of Pulmonary Rehabilitation in Children. Chinese Journal of Applied Clinical Pediatrics, 37(18): 1434–1437.

[8] Tang X, Jiang X, Wei J, et al., 2023, Research Progress of Pulmonary Rehabilitation Nursing for Pediatric Respiratory Diseases. Chinese Journal of Clinical Nursing, 15(7): 446–449.

[9] Shen X, Ding X, Liu H, 2024, Common Respiratory Function Training and Implementation Strategies. Shanghai Nursing Journal, 24(4): 71–75.

[10] Zhang N, Dong X, 2026, Effects of Respiratory Function Training on Pulmonary Function and Complications in Children with Mycoplasma Pneumoniae. Journal of Yanbian University (Medical Science), 49(4): 45–47.

[11] Li J, Li J, Lu X, et al., 2025, Application of Respiratory Function Training in Rehabilitation Nursing of Children with Pulmonary Consolidation. Women and Children's Health Guide, 4(9): 126–130.

[12] Wang L, An H, 2026, Application of Respiratory Exercises Combined with Pediatric Early Warning Score in Children with Lobar Pneumonia. Medical Frontier, 16(13): 107–110.

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Research on the Digital Divide and Outpatient Appointment Barriers Among the Elderly

Hongjia Quan, Rumei Li

The Second Affiliated Hospital of Harbin Medical University, Harbin 150086, Heilongjiang, China

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Abstract: With the continuous deepening of population aging and the rapid advancement of digital healthcare in China, most fair and transparent outpatient registration quotas are allocated via mobile applications, leaving very limited on-site registration quotas for older people. However, the existence of the digital divide exposes older people to numerous barriers in the process of outpatient appointment registration, seriously undermining their medical convenience and sense of access. Adopting a combination of literature research and logical analysis, this paper systematically sorts out the specific manifestations of older people's digital divide and outpatient appointment barriers, deeply analyzes multiple causes of such barriers, and proposes targeted solutions combined with current practices of age-friendly medical construction. It aims to provide theoretical reference and practical lessons for bridging the older people's digital divide, optimizing outpatient appointment services, safeguarding older people's medical rights and interests, and facilitating the realization of healthy aging.

Keywords: Older people; Digital divide; Outpatient appointment; Medical access barriers; Age-friendly transformation

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1. Introduction

At present, China's aging process is accelerating continuously. By the end of 2023, the population aged 60 and above had reached 297 million, accounting for 21.1% of the total population, and the medical service demands of the elderly group are increasingly urgent. Meanwhile, digital transformation drives the upgrading of medical service models, and outpatient appointments have become an important measure to optimize the allocation of medical resources and reduce waiting time for older people seeking medical treatment. Nevertheless, the rapid iteration of digital technology has given rise to the digital divide among older people. Most older adults struggle with outpatient appointments due to an inability to use smart devices and unfamiliarity with online operations [1]. This divide not only aggravates the difficulty of medical treatment for older people but also runs counter to the healthy aging strategy. Therefore, systematic research on the manifestations, causes, and solutions of older people's digital divide and outpatient appointment barriers is of important practical and theoretical significance for improving the elderly medical service system, protecting

the basic health rights and interests of older people, and promoting the universal benefit of digital healthcare.

2. Specific manifestations of older people's digital divide and outpatient appointment barriers

2.1. Insufficient access to digital equipment and a weak foundation for appointment

Access to digital equipment is the prerequisite for outpatient appointments, while older people have obvious shortcomings in equipment acquisition and use, forming fundamental barriers to outpatient appointments. Restricted by economic conditions, some older adults are not equipped with smart terminals such as smartphones and tablets, and still rely on basic feature phones that cannot log in to appointment platforms for operation. Even if they own smart devices, most are second-hand, old devices eliminated by their children, suffering from lagging operation and blurry screens, which affects the fluency of appointment operations.

In addition, elderly residents in rural and remote areas face insufficient network coverage with unstable 4G and 5G signals, and some lack home network access, making them unable to stably access online appointment systems. They can only rely on offline registration and lose the convenience brought by online appointments [2]. This access-level divide puts older people at a disadvantage from the very beginning of outpatient appointments, making it difficult for them to enjoy the dividends of digital healthcare.

2.2. Deficient digital operational competence and blocked appointment process

Older people's inadequate digital operational ability is the core manifestation of outpatient appointment barriers and a direct reflection of the digital divide in usage. Outpatient appointments involve multiple procedures, including downloading apps, registration and login, binding medical cards, selecting departments and doctors, and confirming appointment information. Due to declining cognitive ability and memory loss, the elderly struggle to quickly master the operational process.

Most older adults cannot download or update apps, feel confused by operations such as entering SMS verification codes and filling in identity information during registration, and even fail to make appointments due to operational errors. Some elderly individuals who complete registration cannot accurately locate the appointment entrance or select appropriate medical time slots. They are often at a loss when faced with complex interface design and cumbersome operational steps [3]. Furthermore, the operational procedures of some appointment platforms are constantly updated, making newly learned methods obsolete quickly. The learning pace of older people cannot keep up with technological iteration, further increasing the difficulty of making appointments.

2.3. Inadequate digital information literacy and poor appointment experience

Insufficient digital information literacy makes it hard for older people to identify valid information in outpatient appointments, leading to misunderstandings and impairing their appointment experience and medical safety. At present, various medical appointment platforms are emerging in large numbers. Some unofficial platforms engage in false publicity and illegal charging. Lacking the ability to distinguish information, older people are prone to falling into fake appointment channels, which not only results in appointment failure but also may lead to personal information leakage and property losses.

On official appointment platforms, a large amount of medical information and appointment rules are expressed in professional and obscure language, which older people can hardly understand accurately.

They often make appointments with mismatched departments for their conditions, resulting in low medical efficiency [4]. Meanwhile, older people pay little attention to reminder messages and medical instructions after successful appointments. Some miss the appointment time or fail to carry the relevant documents, causing the appointment to be invalid and wasting time and energy.

3. Countermeasures for older people's digital divide and outpatient appointment barriers

3.1. Strengthen the cultivation of older people's digital literacy and improve their independent appointment ability

Improving older people's digital operational ability is the core measure to break outpatient appointment barriers and bridge the digital divide. Targeted training should be carried out in accordance with the physiological and cognitive characteristics of older people, balancing practicality and operability. A hierarchical and classified training system should be established. Based on differences in age, educational level, and digital foundation of the elderly, training content should be precisely set.

For the advanced-aged, low-educated elderly with no digital foundation, training should focus on basic outpatient appointment operations to reduce learning difficulty, emphasizing basic steps such as powering on smart devices, downloading and installing apps, and finding appointment entrances [5]. For older people with certain digital foundations, training should focus on skill improvement, including optimizing appointment procedures, distinguishing appointment information, and handling abnormal problems, helping them cope with various emergencies in the appointment process.

The training mode combines offline centralized teaching with one-on-one targeted assistance. Relying on community service centers, senior universities, medical institutions, and elderly care service institutions, volunteers, medical staff, and community workers are invited to provide on-site guidance and hands-on teaching of the entire outpatient appointment process. Meanwhile, easy-to-understand graphic operation manuals and slow-speed short video tutorials marked with key operational nodes should be produced for older people to check and review repeatedly, reducing memory difficulty.

The core role of family assistance should be strengthened, guiding children to take the initiative to provide guidance. Children are encouraged to accompany the elderly to learn smart device operation and outpatient appointment procedures in their spare time, explaining key steps such as app registration, medical card binding, department and doctor selection, and appointment confirmation at a pace acceptable to older people, and correcting operational errors in a timely manner to build their operational confidence.

In addition, efforts should be made to change older people's resistance to digital technology. Through case explanation and on-site demonstration, older people can intuitively perceive the convenience of online appointments, such as queuing-free and time-saving, enhancing their willingness to take the initiative to learn, guiding them to attempt independent appointments and gradually get rid of dependence on others to achieve independent integration into digital healthcare [6]. For solitary and empty-nest elderly, community support forces should be relied on to arrange special personnel for regular door-to-door guidance, ensuring they can complete outpatient appointments smoothly without assistance.

3.2. Build regular community digital service stations

Communities can build regular digital service stations, integrating retired nursing staff, nursing interns, grid

staff, retired teachers, technical volunteers, and other forces. Fixed service hours are set up in community activity centers and elderly care service stations to provide convenient services of learning and consulting anytime for older adults needing outpatient appointments.

The service stations are equipped with simple operation guide display boards and enlarged-font process schematic diagrams, as well as spare smart devices for older people to practice operation. Volunteers provide special tutoring on common appointment problems such as account login, SMS verification code reception, and appointment time adjustment.

Furthermore, communities can regularly hold "Digital Medical Experience Day" activities, cooperating with local medical institutions to carry out interactive sessions such as on-site simulated appointments and online consultation demonstrations, enabling older people to familiarize themselves with operational procedures in real scenarios. For older people with limited mobility, communities can launch a dual service of door-to-door agency + hands-on teaching, assisting with appointment making while patiently explaining operational key points to help older people gradually master independent appointment skills, effectively opening up the "last mile" of digital medical treatment for older people.

3.3. Optimize age-friendly design of appointment platforms and lower operational threshold

In view of the insufficient age-friendly design and great operational difficulty of current outpatient appointment platforms, platforms should be upgraded and optimized to fully adapt to the physiological characteristics and usage habits of older people and effectively lower the appointment threshold. Simplify the operation interface, cut redundant functional modules, and highlight the core functions of outpatient appointments. Key modules such as appointment entrance, department selection, doctor inquiry, and appointment records should be placed in prominent positions on the homepage with enlarged fonts and improved color contrast to avoid unclear operation content caused by tiny fonts and blurred colors.

Integrate AI recognition and activate voice recognition to enable fast intelligent registration via voice command. Add age-friendly functions including voice guidance, one-click appointment, screen magnification, and night mode. Voice guidance should adopt a slow and gentle broadcast speed to clearly explain each operational step and help the elderly complete appointments accurately. The one-click appointment function can be directly associated with commonly used departments and doctors to reduce operational steps [7].

Optimize the registration and login process by reducing unnecessary verification procedures, supporting quick login with ID cards and children's agency binding, allowing children to complete account registration and information improvement for older people, and avoiding appointment failure caused by complex verification operations. For older people prone to password forgetting, add convenient password retrieval channels supported by SMS verification and children-assisted retrieval to improve operational convenience.

Enhance platform adaptability, optimize compatibility with feature phones and old smart devices, and fix problems such as crashes and lag to ensure smooth appointment operation. Increase investment in network infrastructure in rural and remote areas, improve the stability of 4G and 5G signals, and ensure older people can stably access online appointment systems without network interference. Improve platform service support by adding a special artificial customer service hotline with extended service hours, arranging professional personnel to provide appointment consultation, operational guidance, and problem troubleshooting, solving various difficulties encountered by older people during appointments, and improving their appointment experience.

3.4. Improve the social assistance system and consolidate the safety net of guarantees

Build a diversified and collaborative social assistance system, integrate resources from all parties to provide all-around support for older people to cross the digital divide and complete outpatient appointments smoothly, and consolidate the bottom-line guarantee. Give play to the role of grassroots community governance, establish a digital assistance mechanism for the elderly, and set up assistance teams composed of community workers, volunteers, and medical staff to provide personalized services such as door-to-door appointment making, accompanying medical treatment, and appointment information reminder for special elderly groups, including solitary, advanced-aged, and disabled seniors, solving their difficulty in independent appointment [8].

Communities should regularly carry out exchange activities on outpatient appointment operations, build a platform for mutual learning among older people, and encourage digitally skilled older adults to drive their peers to learn, forming a good atmosphere of mutual assistance and progress. Meanwhile, set up age-friendly appointment service posts in community service halls with special personnel on-site to guide operations and provide appointment consultation and information verification services for older people.

Optimize publicity and guidance methods and expand publicity channels with both online and offline promotion. Offline, popularize outpatient appointment knowledge, operational methods, and precautions to older people through community announcements, billboards, household visits, and paper manuals, interpreting appointment rules in plain language. Online, release simplified appointment tutorials via social channels commonly used by older people to ensure accurate coverage of publicity information.

At the same time, create a social atmosphere of caring for and assisting older people to cross the digital divide, guiding medical institutions, enterprises, and social organizations to take social responsibilities actively. Encourage enterprises to participate in age-friendly technology research and development and assistance services, donating smart devices, and providing free network services for older people [9]. Strengthen training for service personnel to enhance their service awareness and patience, guide them to take the initiative to care about older people's operational difficulties, and offer more tolerance and help, avoiding dampening older people's learning enthusiasm due to poor service attitude.

3.5. Improve the policy guarantee mechanism and promote service connection and optimization

Strengthen policy guidance, improve supporting policies, clarify the responsibilities of medical institutions, platform operators, communities, and other relevant parties, and promote the implementation of various age-friendly measures. Strictly implement national policies on convenient medical treatment for older people, requiring medical institutions at all levels to retain sufficient manual registration windows, reasonably allocate on-site registration quotas for older people, and refrain from arbitrarily reducing or canceling offline registration services to protect their rights to offline registration.

Increase investment in digital medical construction of grassroots medical institutions, promote the launch of online appointment services in grassroots hospitals, optimize the allocation of appointment quotas with preferential allocation to the elderly to facilitate nearby medical treatment and convenient appointments. Establish and improve a policy supervision and assessment mechanism, regularly inspect the implementation of age-friendly services by medical institutions and appointment platforms, and supervise and rectify units that fail to implement policies strictly, reduce manual windows or allocate registration quotas unreasonably, so as to protect the legitimate medical rights and interests of older people [10].

Promote in-depth connection between online and offline services, optimize appointment procedures, realize synchronous information update to diagnosis and treatment systems and medical insurance systems after successful appointments, reduce on-site verification and queuing time for older people, and give full play to the convenience of online appointments. Promote the interconnection of appointment platforms across different hospitals to realize universal accounts and information sharing, avoiding repeated app downloading and account registration for the elderly, and further lowering appointment difficulty.

4. Conclusion

The digital divide and outpatient appointment barriers among older people are prominent social issues against the backdrop of overlapping aging and digitalization, which not only affect the medical convenience and sense of gain of older people but also restrict the advancement of the healthy aging strategy. Their formation results from the combined effect of multiple factors, including the elderly's physiological and cognitive characteristics, insufficient age-friendly technological supply, imperfect social support system, and poor connection between policy and medical systems.

To solve this problem, we should base our efforts on the needs of older people, coordinate forces from all sides, bridge the digital divide, and break appointment barriers by strengthening digital literacy cultivation, optimizing age-friendly platform design, improving social assistance, and perfecting policy guarantees. Only in this way can older people better enjoy the convenience of digital medical treatment, protect their basic health rights and interests, promote the goal of universal access to basic medical and health services, and build a warmer and more inclusive aging society.

Disclosure statement

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References

[1] Cao Y, Liu N, Wang H, et al., 2024, Influence of Cluster Outpatient Management Model on Improving Medical Experience of Elderly Outpatients in General Hospitals. Chinese Journal of Geriatric Health Care, 22(06): 156–160.

[2] Wang T, An Y, 2024, Wisdom + Service: Smoother Medical Journey for the Elderly. Xinhua Daily, 2024-10-16(015).

[3] Liu Q, 2024, Research on the Satisfaction of Digital Medical Services Among the Elderly in Shanghai from the Perspective of Perceived Value, thesis, East China Normal University.

[4] Chen X, 2024, Research on the Dilemma of Smart Medical Treatment for the Elderly and Coping Strategies of Medical Social Work, thesis, Southeast University.

[5] Wang J, 2024, Analysis on the Digital Inclusion Dilemma of the Elderly in Outpatient Departments and Construction of Smart Elderly-Assisting Model, thesis, Jiangsu University.

[6] Zhu Y, Ye X, Zhang L, 2023, Age-Friendly Construction of Outpatient Services Under the Background of "Digital Healthcare". Modern Hospital, 23(11): 1649–1651.

[7] Zhu H, Liu J, Li Z, et al., 2023, Influencing Factors of Outpatient Registration Among Elderly Patients: An

Empirical Study Based on Andersen's Health Behavior Model. Chinese Journal of Health Resources, 26(03): 286–292.

[8] Outpatient Department of West China Hospital, Sichuan University, 2022, Takes Multiple Measures to Address the Elderly's Digital Divide in Medical Treatment. Chinese Journal of Reparative and Reconstructive Surgery, 36(11): 1445–1446.

[9] Zeng J, 2022, Practice of the Elderly in Smart Hospital Medical Treatment from the Perspective of Actor-Network Theory, thesis, Southwest University of Political Science and Law.

[10] Zhang S, 2022, The Impact of Internet Use on Health and Medical Resource Utilization Among Middle-Aged and Elderly People, thesis, Southwestern University of Finance and Economics.

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A Retrospective Clinical Comparative Study of Acupuncture Combined with Huolong Cupping Therapy for Low Back Pain of Qi Stagnation and Blood Stasis Pattern

Huali Gao[1], Yinghan Chu[2], Chang'e Kuang[3,4]*

[1]Department of Pediatrics and Acupuncture, Second District, The Affiliated Traditional Chinese Medicine Hospital, Guangzhou Medical University, Guangzhou 510000, Guangdong, China
[2]Guangzhou Chunxuanmao Senior Living Services Co., Ltd., Guangzhou 510000, Guangdong, China
[3]Department of Spine Surgery, The Sixth Affiliated Hospital, Sun Yat-sen University, Guangzhou 510000, Guangdong, China
[4]Guangzhou (Huangpu) Zhongliu Biomedical Innovation Center, Guangzhou, 510000, Guangdong, China

***Corresponding author**: Chang'e Kuang, kuangche@mail.sysu.edu.cn

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Abstract: *Objective*: To observe the clinical efficacy of acupuncture combined with Huolong cupping therapy in alleviating pain in patients with degenerative lumbar diseases presenting a Qi stagnation and blood stasis pattern, so as to provide evidence for optimizing conservative treatment regimens in clinical practice. *Methods*: A total of 116 inpatients diagnosed with degenerative lumbar diseases of Qi stagnation and blood stasis pattern admitted to the Acupuncture Department of our hospital from January 2024 to January 2026 were retrospectively enrolled. According to different rehabilitation interventions, the patients were divided into the control group (40 cases, treated with acupuncture alone) and the observation group (76 cases, treated with acupuncture plus Huolong cupping therapy). Both groups received 10 treatment sessions as one therapeutic course. The Visual Analog Scale (VAS) was adopted to evaluate the degree of low back pain at 1 day before treatment, as well as on the 3rd, 6th, 9th, and 11th day after treatment. An independent-samples *t*-test was used for comparison of measurement data, and a chi-square test was applied for enumeration data. *Results*: There were no statistically significant differences in baseline data, including age, gender, height, weight, and body mass index (BMI), between the two groups ($p > 0.05$), indicating comparability. No significant difference in VAS scores was observed between the two groups 1 day before treatment ($p = 0.087$). On the 3rd day after treatment, the VAS scores of both groups increased compared with the baseline, with no significant inter-group difference ($p = 0.494$). Starting from the 6th day after treatment, the VAS score of the observation group was significantly lower than that of the control group (4.24 ± 0.09 vs. 4.58 ± 0.13, $p = 0.036$). On the 9th day (1.95 ± 0.07 vs. 2.85 ± 0.14, $p < 0.0001$) and the 11th day (0.64 ± 0.09 vs. 1.85 ± 0.16, $p < 0.0001$), the VAS scores of the observation group remained markedly lower than those of the control group. *Conclusion*: Acupuncture combined with Huolong cupping therapy can significantly relieve low back pain from the middle stage (the 6th day of treatment) in patients with degenerative lumbar diseases of

Qi stagnation and blood stasis pattern. The pain degree nearly reaches the pain-free level on the 11th day of treatment, and the overall efficacy is superior to acupuncture monotherapy. This combined therapy is safe and worthy of clinical promotion in acupuncture departments.

Keywords: Degenerative lumbar diseases; Qi stagnation and blood stasis; Low back pain; Acupuncture; Huolong cupping therapy

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1. Introduction

Degenerative lumbar diseases are one of the most common causes of lumbocrural pain in middle-aged and older adults, mainly including lumbar intervertebral disc herniation and lumbar spinal stenosis. The main clinical manifestations include distending pain of the waist and limited lumbar movement, accompanied by radiating pain in the buttocks and lower limbs, which seriously affects patients' daily activities and quality of life. Modern epidemiological studies show that with the prevalence of sedentary work, decreased physical activity, and population aging, the incidence of this disease increases year by year and tends to affect younger populations, imposing a heavy medical burden on families and society [1]. From the perspective of pathology, degenerative intervertebral discs, hyperplastic articular processes, and thick ligaments lead to mechanical imbalance of the lumbar spine and compression of nerve roots. In traditional Chinese medicine (TCM), this disease is categorized as lumbago or bi syndrome, and the Qi stagnation and blood stasis pattern is the most common type. It is usually caused by strain, trauma, or emotional disturbance, which leads to stagnation of meridians and blood. The core pathogenesis is that stagnation causes pain [2].

At present, conservative treatment is the first choice for degenerative lumbar diseases, especially for patients without severe nerve compression or surgical indications. The basic therapeutic principles are activating blood circulation to dissipate stasis, regulating Qi to relieve pain, and dredging meridians. As a classic external TCM therapy, acupuncture can relax meridians, harmonize Qi and blood, and relieve muscle spasm by stimulating acupoints such as lumbosacral Jiaji points and Shenshu points. It has definite curative effects on low back pain and has been recommended as a basic intervention by multiple clinical guidelines [3]. However, clinical practice reveals that acupuncture alone has limited effects on releasing adhesion of deep soft tissues and relieving myofascial tension. Some patients experience slow pain relief and long treatment courses, which fail to meet the demand for rapid rehabilitation [4].

Huolong cupping therapy is a combined external TCM technique that integrates moxibustion for warming and unblocking meridians, negative-pressure cupping and tuina for tendon regulation. Combined thermal stimulation and mechanical compression effects enable this therapy to warm meridians, dispel cold, activate blood circulation and remove stasis, as well as release tendon nodules. It is especially suitable for pain disorders caused by Qi stagnation, blood stasis, and cold-damp retention [5]. Operated along the Governor Vessel and Bladder Meridian, it can stimulate meridian Qi, improve local microcirculation, and accelerate the metabolism of pain-causing substances. Combined with acupuncture, the two therapies complement each other with respective advantages [6]. Nevertheless, comparative studies on acupuncture combined with Huolong cupping therapy for degenerative lumbar diseases of Qi stagnation and blood stasis pattern are still insufficient. The intervention timing, efficacy characteristics, and clinical value of this combined regimen

require further verification.

In this study, 116 patients with degenerative lumbar diseases of Qi stagnation and blood stasis pattern were enrolled retrospectively and treated with acupuncture alone or acupuncture combined with Huolong cupping therapy, respectively. The VAS score was taken as the main observation indicator. We dynamically compared pain changes at 1 day before treatment and on the 3rd, 6th, 9th, and 11th day after treatment, so as to explore the clinical advantages of the combined therapy and provide objective evidence for optimizing conservative treatment and rehabilitation schemes for degenerative lumbar diseases.

2. Materials and methods

2.1. General data

A total of 116 inpatients with degenerative lumbar diseases admitted to the Acupuncture Department of our hospital from January 2024 to January 2026 were retrospectively enrolled. The patients were divided into the control group (n = 40) and the observation group (n = 76) according to different rehabilitation interventions.

2.1.1. Inclusion criteria

(1) Aged over 18 years old;
(2) Diagnosed with degenerative lumbar diseases (lumbar intervertebral disc herniation, lumbar spinal stenosis, etc.) via MRI or CT examination, with consistent clinical manifestations and imaging results;
(3) Compliant with the diagnostic criteria for lumbar intervertebral disc herniation specified in *Criteria for Diagnosis and Therapeutic Effect of TCM Diseases*: persistent distending pain in the waist with obvious tenderness, or distending pain in the buttocks and lower limbs, accompanied by limited lumbar movement to varying degrees [7];
(4) Differentiated as Qi stagnation and blood stasis pattern based on TCM syndrome differentiation;
(5) Follow-up duration no less than 12 months with complete clinical and imaging data.

2.1.2. Exclusion criteria

(1) Grade II or above lumbar spondylolisthesis, severe scoliosis or kyphosis;
(2) History of lumbar surgery, spinal infection, spinal tumor, spinal tuberculosis and other related diseases;
(3) Combined with severe dysfunction of heart, lung, liver, kidney and other vital organs, unable to tolerate treatment;
(4) Coagulopathy, mental disorders and other conditions affecting treatment and follow-up.

2.2. Treatment methods

A fixed team of experienced acupuncturists and nurses performed all treatments. Physicians performed acupuncture, while nurses operated Huolong cupping devices. Relevant examinations were completed before treatment to confirm the lesion segments and ranges.

2.2.1. Control group

Treated with acupuncture alone.

(1) Main acupoints

Ashi points (tenderness points), Mingmen (GV4), Shenshu (BL23), Lumbosacral Jiaji points,

Yaoyangguan (GV3), Weizhong (BL40), Chengfu (BL36), Fengshi (GB31), Xuanzhong (GB39).

(2) Adjunct acupoints

Were selected according to symptoms, including Zhibian (BL54), Baliao points, Huantiao (GB30), Yanglingquan (GB34), Yinlingquan (SP9), and Kunlun (BL60).

Acupuncture once daily. One course consisted of 10 days' acupuncture, and all patients received one course of treatment.

2.2.2. Observation group

Received Huolong cupping therapy on the basis of the same acupuncture regimen as the control group.

Patients took the prone position to expose the lumbar region fully. Appropriate Huolong cups were selected. After moxa cones were ignited inside the cups, the cups were moved along the Governor Vessel, Bladder Meridian, and painful areas of the waist. Manipulations included tapping, shaking, pressing, rolling, pushing, kneading, plucking, rubbing, ironing, and rolling. The treatment was terminated when local skin became flushed and warm without burning pain. Each session lasted for 30 minutes, once every other day, 5 sessions for one course, and all patients received one course of treatment. Routine treatment and nursing of the control group were also provided.

2.3. Observation indicators

2.3.1. Baseline data

Age, gender, height, weight, and BMI of all patients.

2.3.2. Therapeutic indicator

VAS score for low back pain. The score ranges from 0 (painless) to 10 (severe pain). Scores were recorded 1 day before treatment and on the 3rd, 6th, 9th, and 11th days after treatment, respectively.

2.4. Statistical methods

SPSS 22.0 statistical software was used for data analysis. Measurement data were expressed as mean ± standard deviation ($\overline{x} \pm s$), and compared by independent-samples *t*-test. Enumeration data were compared by a chi-square test. A *P* value less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of baseline data between two groups

(1) In the observation group

32 males and 44 females; mean age (59.05 ± 2.10) years old; mean height (161.4 ± 0.91) cm, mean weight (63.35 ± 1.37) kg, BMI range 17.67–34.53kg/m^2, mean BMI (24.24 ± 0.44 kg/m^2).

(2) In the control group

23 males and 17 females; mean age (59.05 ± 2.10) years old; mean height (164.3 ± 1.25) cm, mean weight (64.68 ± 1.61) kg, BMI range 17.43–32.53kg/m^2, mean BMI (23.95 ± 0.53) kg/m^2.

There were no statistically significant differences in age, gender, height, weight, and BMI between the

two groups ($p > 0.05$), which indicated the two groups were comparable. (See **Table 1**)

Table 1. Comparison of baseline data between the two groups

Index	Control group (n = 40)	Observation group (n = 76)	t/χ^2	*p* value
Age (years old)	59.05 ± 2.10	57.57 ± 1.65	0.54	0.589
Gender (Male)	23	32	2.49	0.115
Gender (Female)	17	44	-	-
Height (cm)	164.3 ± 1.25	161.4 ± 0.91	1.86	0.065
Weight (kg)	64.68 ± 1.61	63.35 ± 1.37	0.60	0.550
BMI (kg/m^2)	23.95 ± 0.53	24.24 ± 0.44	0.41	0.682

3.2. Comparison of VAS scores before and after treatment

One day before treatment: VAS score of the observation group was 3.46 ± 0.07, and that of the control group was 3.65 ± 0.07, with no significant difference between the two groups ($t = 1.73$, $p = 0.087$).

On the 3rd day after treatment: VAS score of the observation group was 4.61 ± 0.06, control group 4.68 ± 0.08, with no significant difference ($t = 0.69$, $p = 0.494$).

On the 6th day after treatment: VAS score of the observation group was 4.24 ± 0.09, significantly lower than 4.58 ± 0.13 of the control group ($t = 2.13$, $p = 0.036$).

On the 9th day after treatment: VAS score of the observation group was 1.95 ± 0.07, obviously lower than 2.85 ± 0.14 of the control group ($t = 6.66$, $p < 0.0001$).

On the 11th day after treatment: VAS score of the observation group was 0.64 ± 0.09, markedly lower than 1.85 ± 0.16 of the control group ($t = 6.93$, $p < 0.0001$). (See **Table 2**)

Table 2. Comparison of VAS scores at different time points before and after treatment

Time point	Control group	Observation group	*t* value	*p* value
1 day before treatment	3.65 ± 0.08	3.46 ± 0.07	1.73	0.087
3rd day after treatment	4.68 ± 0.08	4.61 ± 0.06	0.69	0.494
6th day after treatment	4.58 ± 0.13	4.24 ± 0.09	2.13	0.036
9th day after treatment	2.85 ± 0.14	1.95 ± 0.07	6.66	< 0.0001
11th day after treatment	1.85 ± 0.16	0.64 ± 0.09	6.93	< 0.0001

4. Discussion

Degenerative lumbar disease is a common chronic painful disorder in acupuncture departments. Patients with Qi stagnation and blood stasis pattern mainly present with lumbocrural distending pain and limited movement caused by blocked meridians and poor blood circulation. The core therapeutic principles are dredging meridians, activating blood circulation, regulating Qi, and relieving pain [2]. The 116 enrolled patients had balanced baseline data and similar preoperative pain levels, which guaranteed the reliability of efficacy comparison. The results proved that acupuncture combined with Huolong cupping therapy was superior to acupuncture alone in alleviating low back pain, providing evidence-based support for the rehabilitation of patients with degenerative lumbar diseases of Qi stagnation and blood stasis pattern.

Acupuncture has formed a mature acupoint selection scheme for this disease. Needling Ashi points, Mingmen, Shenshu, and lumbosacral Jiaji points can directly act on the lesion areas, dredge lumbar meridians

and Qi-blood, and regulate local nerve and muscle tension. It is a basic external therapy for low back pain [3]. The VAS scores of the control group decreased gradually after single acupuncture treatment, which confirmed the definite curative effect of acupuncture on degenerative lumbar pain. However, acupuncture has limited effects on improving local microcirculation, releasing fascia, and eliminating inflammation. There is room for improvement in pain relief speed and long-term control effect.

The observation group adopted combined therapy, which embodied the advantages of integrating multiple external TCM therapies. Integrating moxibustion warming effect, negative-pressure cupping, and Tuina manipulation, Huolong cupping therapy is operated along the Governor Vessel and Bladder Meridian to warm and unblock meridians, activate blood circulation and remove stasis, and relieve myofascial spasm. From the perspective of modern medicine, its thermal effect can increase local blood flow and accelerate the metabolism of pain-causing substances. Negative pressure and manual manipulation can inhibit pain signal transmission and promote the release of endogenous opioid peptides, so as to achieve sustained analgesia [8]. In this study, the VAS scores of the two groups showed no difference on the 3rd day, indicating a similar early stress response. From the 6th day onwards, the VAS score of the observation group decreased significantly, and the difference was more prominent on the 9th and 11th days. This suggested that the combined therapy could enter the rapid pain relief stage earlier with a longer-lasting analgesic effect.

It is noteworthy that the VAS scores of both groups increased on the 3rd day compared with baseline (control group: from 3.65 to 4.68; observation group: from 3.46 to 4.61). This phenomenon may be attributed to slight tissue irritation caused by acupuncture, a normal inflammatory response during Deqi (needle sensation), as well as patients' psychological expectation and tension [9]. Besides, the long-term pathological state of patients was broken in the early stage of treatment, leading to rapid changes in local blood circulation and metabolism, which may also cause transient aggravation of pain [10]. Although the increase range of VAS score in the observation group was slightly lower than the control group (+ 1.03 vs. + 1.15), the difference had no statistical significance, which meant both regimens experienced a similar short-term reaction period in the early treatment stage.

The pain relief advantage of the observation group gradually emerged from the 6th day. On the 11th day, the VAS score of the observation group dropped to 0.64 ± 0.09, close to the pain-free level, while the control group still scored 1.85 ± 0.16. Such time-dependent efficacy differences reflected the synergistic effect of Huolong cupping combined with acupuncture [11]. Various manipulations, including tapping, rolling, and pressing of Huolong cups, can mechanically release adhered fascia and muscles, reduce local muscle tension, and cut off the vicious cycle of pain-spasm-ischemia-pain [12]. Thermal stimulation can up-regulate the release of endogenous opioids such as beta-endorphin, and enhance the regulatory effect of descending inhibitory pathways on pain signals [13]. Compared with single acupuncture, Huolong cupping delivers deeper and longer-lasting physical stimulation. Since inflammation elimination and tissue repair require time for accumulation, its advantages become prominent in the middle and late treatment stages (after the 6th day).

From the perspective of TCM theory, all enrolled patients were diagnosed with a Qi stagnation and blood stasis pattern. Acupuncture at Ashi points, Shenshu, and Weizhong can activate blood circulation and relieve pain. On the basis of acupuncture, Huolong cupping adds warming and rubbing effects. As the old TCM saying goes: Blood flows smoothly when warmed and stagnates when chilled. Thermal power promotes blood circulation, and rubbing manipulations disperse blood stasis. The combination perfectly matches the pathogenesis of Qi stagnation and blood stasis. Meanwhile, rolling, plucking, and other manipulations of

Huolong cupping simulate Tuina therapy to further release deep lumbar soft tissues and improve lumbar mobility. Acupuncture focuses on regulating Qi via acupoints, while Huolong cupping emphasizes warming meridians and removing stasis. The combination works together to relieve Qi stagnation and blood stasis, and improve patients' activity and comfort more efficiently.

This study is a retrospective research with a limited sample size, which may lead to selection bias and recall bias. Indicators such as lumbar function and quality of life were not included, and the follow-up only lasted until the 11th day after treatment. Long-term follow-up data (1 month, 3 months) were lacking, so the long-term efficacy and recurrence rate could not be evaluated. VAS is a subjective scale, easily affected by patients' mental state, educational background, and trust in TCM treatment. Parallel detection of objective inflammatory indicators such as C-reactive protein and tumor necrosis factor-α, as well as mechanism exploration, were not conducted. All the above are limitations of this research. In the future, prospective, multi-center, and large-sample randomized controlled trials shall be carried out with extended follow-up duration. Combined with inflammatory factors, hemodynamic detection, imaging, and laboratory indicators, comprehensive evaluation will be conducted further to verify the efficacy and mechanism of this combined therapy.

5. Conclusion

In conclusion, acupuncture combined with Huolong cupping therapy can rapidly and significantly relieve low back pain in patients with degenerative lumbar diseases of Qi stagnation and blood stasis pattern, with reliable safety. It is worthy of wide application in clinical acupuncture departments.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Spinal Pain Group, Chinese Society of Pain Medicine, 2020, Chinese Expert Consensus on Diagnosis and Treatment of Lumbar Intervertebral Disc Herniation. Chinese Journal of Pain Medicine, 26(1): 2–6.

[2] Zhou J, Ran J, Tian H, et al., 2023, Research Progress of External TCM Therapies for Lumbar Intervertebral Disc Herniation with Qi Stagnation and Blood Stasis Pattern. Nursing Journal of China, 12(3): 375–380.

[3] Ge L, Li J, Shang W, et al., 2024, Evidence-Based Guidelines for Non-Surgical Treatment of Lumbar Intervertebral Disc Herniation. Chinese Journal of Evidence-Based Medicine, 24(02): 125–148.

[4] Ren T, 2025, Clinical Observation on Combined Therapy of TCM Tuina and Warm Acupuncture for Lumbar Intervertebral Disc Herniation. Chinese and Foreign Medical Research, 4(9): 97–99.

[5] Wang Y, Gao Z, Zhang S, et al., 2024, Research Progress on Clinical Application and Mechanism of Huolong Cupping Therapy. Advances in Clinical Medicine, 14(7): 877–882.

[6] Dong H, Yang J, Yuan A, et al., 2021, Clinical Observation on Fire Therapy Combined with Acupuncture for Lumbar Intervertebral Disc Herniation with Qi Stagnation and Blood Stasis Pattern. Chinese Folk Therapies, 29(3): 40–42.

[7] State Administration of Traditional Chinese Medicine, 2017, Criteria for Diagnosis and Therapeutic Effect of

TCM Diseases. Beijing: China Press of Traditional Chinese Medicine: 214.

[8] Ye Q, Zhu J, Ju Y, et al., 2025, Research Progress of External TCM Therapies for Lumbar Intervertebral Disc Herniation. Guiding Journal of Traditional Chinese Medicine and Pharmacy, 31(9): 126–130.

[9] Du R, Zhang C, Li X, et al., 2025, Mechanism and Clinical Research Progress of Acupuncture for Anxiety Disorders. Advances in Clinical Medicine, 15(10): 2363–2369.

[10] Zhang C, Yan L, Luo B, et al., 2021, Research Progress of Microcirculation Imaging Technology in Analgesic Mechanism of Acupuncture. Journal of Hunan University of Chinese Medicine, 2021(6): 972–976.

[11] Lv S, Chen H, 2024, Application Progress of Comprehensive Huolong Moxibustion in Clinical Nursing. Integrated Chinese and Western Nursing, 10(4): 71–76.

[12] Yuan W, Pan C, Zheng H, et al., 2025, Meta-Analysis on Efficacy and Safety of Tuina for Skeletal Muscle Injury. Practical Surgery Innovation, 1(1): 30–34.

[13] Huang B, Ruan L, Wang L, 2023, Research Progress on Molecular Biological Mechanism of Tuina in Treating Skeletal Muscle Injury. Journal of Hunan University of Chinese Medicine, 43(4): 753–758.

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Evaluation of the Effect of Comprehensive Nursing on Patients with Acute Appendicitis Undergoing Laparoscopic Appendectomy After CT Diagnosis

Fang Yan, Xueqin Ren*

The 944th Hospital of PLA Joint Logistics Support Force, Jiuquan 735000, Gansu, China

Author to whom correspondence should be addressed.

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Abstract: *Objective*: To analyze the nursing effect of comprehensive nursing on patients with acute appendicitis (AA) undergoing laparoscopic appendectomy (LA) diagnosed by CT three-dimensional reconstruction technology (3DSCT). *Methods*: A total of 88 AA patients admitted to the hospital from August 2023 to August 2025 for 3DSCT diagnosis and LA treatment were selected and equally divided using a random number table. The experimental group received comprehensive nursing, while the reference group received conventional nursing. Rehabilitation indicators, postoperative pain scores, complication rates, nursing comfort levels, and satisfaction were compared between the two groups. *Results*: The experimental group demonstrated superior rehabilitation indicators, lower postoperative pain scores, lower postoperative complication rates, higher nursing comfort scores, and higher nursing satisfaction scores compared to the reference group ($p < 0.05$). *Conclusion*: Implementing comprehensive nursing during LA treatment under 3DSCT diagnosis can shorten the postoperative recovery time of AA patients, alleviate their postoperative pain, prevent postoperative complications, enhance nursing comfort, and achieve high patient satisfaction.

Keywords: Acute appendicitis; CT diagnosis; Laparoscopic appendectomy; Comprehensive nursing

Online publication: Jun 30, 2026

1. Introduction

AA is an acute abdominal condition primarily characterized by pain in the lower right abdomen, accompanied by symptoms such as nausea, fever, and vomiting. Delayed treatment may lead to complications such as sepsis, thereby increasing disease risk. Surgery is the fundamental treatment for this condition, enabling complete removal of the appendix, and the key to successful surgery lies in preoperative accurate diagnosis. 3DSCT is a high-resolution diagnostic method that allows clear visualization of the size and location

of the appendix, as well as assessment of its anatomical relationship with surrounding organs, thereby guiding the rational formulation of surgical plans [1]. LA is a relatively novel treatment approach for AA patients, enabling precise removal of appendix tissue under laparoscopic guidance, with advantages such as minimal invasiveness, safety, and definitive efficacy. However, LA is an invasive procedure that may lead to postoperative complications. Therefore, comprehensive postoperative nursing is necessary to comprehensively explain postoperative care points and precautions, improve patient treatment compliance, and ultimately ensure surgical efficacy. Based on this, this study selected 88 AA patients treated with LA under 3DSCT diagnosis to evaluate the intervention effect of comprehensive nursing.

2. Materials and methods

2.1. General information

A total of 88 AA patients admitted to the hospital from August 2023 to August 2025 for 3DSCT examination were selected and equally divided using a random number table. The experimental group consisted of 44 patients, including 27 males and 17 females, aged between 26 and 67 years, with a mean age of (41.58 ± 4.37) years, and a disease duration ranging from 3 to 17 hours, with a mean duration of (10.05 ± 1.49) hours. The reference group consisted of 44 patients, including 28 males and 16 females, aged between 24 and 65 years, with a mean age of (41.71 ± 4.43) years, and a disease duration ranging from 4 to 16 hours, with a mean duration of (10.12 ± 1.60) hours. No significant differences were observed between the two groups ($p > 0.05$).

2.1.1. Inclusion criteria

Confirmed AA diagnosis after 3DSCT examination; age < 70 years; meeting the diagnostic indications for 3DSCT; meeting the surgical indications for LA; acute onset; normal communication ability; able to clearly describe symptoms and highly cooperative with examinations; informed consent for the study.

2.1.2. Exclusion criteria

Coma or concurrent sepsis; abnormal heart, liver, or kidney function; presence of surgical contraindications; inability to tolerate 3DSCT examination; presence of immune system or blood system diseases; withdrawal from the study midway.

2.2. Methods

Both groups of patients underwent 3DSCT examination to confirm AA diagnosis. CT images showed obvious swelling of the mucosal layer of the vessel wall with relatively clear structural boundaries. Significant fluid accumulation was observed within the appendix, accompanied by cystic changes, presenting uneven echoes, and appendiceal enlargement. Periappendiceal gas and fluid accumulation were visible, along with honeycomb inflammatory lesions, as shown in **Figure 1** and **2**.

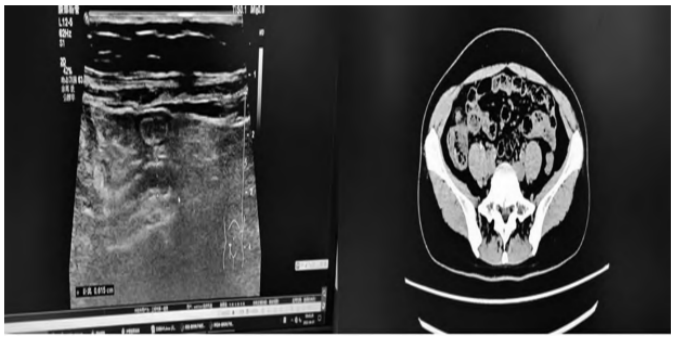


Figure 1. Acute gangrenous appendicitis.

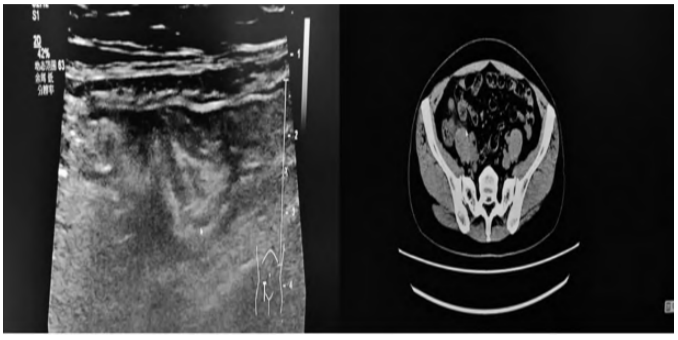


Figure 2. Acute suppurative appendicitis.

The reference group received conventional nursing care after LA surgery, which included distributing health manuals, providing detailed explanations of the self-care process and key nursing points after LA surgery, popularizing the positive role of proper nursing in postoperative recovery, and encouraging patients to actively participate in postoperative nursing practices. Patients were instructed on scientific dietary habits, requiring strict fasting before anal flatus, starting with small amounts of liquid food after flatus, and gradually increasing food intake until transitioning to a regular diet. Moderate exercise was recommended after surgery to promote recovery.

The experimental group received comprehensive nursing care after LA surgery:

(1) Condition observation

Patients were kept in a supine position without a pillow after surgery to prevent aspiration of secretions. Once their vital signs stabilized, they could assume a semi-recumbent position. Continuous monitoring of vital signs was conducted to observe for signs such as pallor and abdominal discomfort, with immediate action taken if abnormalities were detected. Antibiotic therapy was administered for 3 days postoperatively to ensure clean and dry skin at the incision site, checking for bleeding or swelling at the incision. The drainage tube was regularly squeezed to assess its patency, and the volume and color of the drainage fluid were monitored, with any bright red or excessive drainage reported to the doctor.

(2) Knowledge education

Educational materials in the form of brochures or videos were distributed to explain postoperative care procedures, self-care essentials, and cooperation requirements to patients, with a focus on popularizing potential postoperative complications and guiding patients on how to correctly identify and respond to them, thereby alleviating their anxiety. Patients' knowledge gaps were patiently inquired about and

individually addressed in easy-to-understand language. Their anxious or fearful emotions were listened to, and psychological states were improved through verbal counseling, deep breathing exercises, and emotional diversion techniques.

(3) Diet and exercise care

Patients were required to consume liquid food in small, frequent amounts before anal flatus, with personalized meal plans developed based on their dietary preferences, advising them to avoid gas-producing foods and adhere to a high-protein, high-fiber, and high-vitamin diet. Patients were guided to get out of bed early, starting with small-amplitude exercises such as sitting up with bed support once their vital signs stabilized, followed by standing and walking with bed support, gradually increasing exercise intensity.

(4) Pain care

The degree, location, and nature of patients' pain were assessed. For mild pain, distractions such as listening to music, watching TV programs, and reading were utilized to alleviate discomfort. For severe pain, pain medication was administered as prescribed, supplemented by physical methods such as ice packs and massage.

2.3. Observation indicators

(1) Rehabilitation indicators

Observation of indicators such as the recovery time of bowel sounds, anal flatus/defecation time, time to first food intake, and hospital stay.

(2) Postoperative pain score

Assessment using the Visual Analog Scale from postoperative days 1 to 7, with scores ranging from 0 to 10, where higher scores indicate greater pain intensity.

(3) Complication rate

Observation of the incidence of complications such as abdominal abscess, intestinal obstruction, postoperative fever, and incision dehiscence.

(4) Nursing comfort level

The Simplified Comfort Status Scale was used, encompassing four domains: environment, society, physiology, and psychology/spirit, each scored from 1 to 4, with higher scores indicating greater comfort.

(5) Nursing satisfaction

A self-made nursing satisfaction evaluation form was used, covering aspects such as nursing assessment, individual education, service attitude, nursing skills, communication frequency, and specialized guidance, each scored out of 100, with higher scores indicating greater satisfaction.

2.4. Statistical analysis

Data were processed using SPSS 28.0 software. Continuous variables were compared using *t*-tests, while categorical variables were compared using chi-square tests. Statistical significance was considered as $p < 0.05$.

3. Results

3.1. Comparison of rehabilitation indicators between the two groups

After nursing care, the rehabilitation indicators of the experimental group were superior to those of the reference group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of rehabilitation indicators between the two groups [$\overline{x} \pm s$]

Group	Number of cases	Bowel sound recovery time (h)	Anal exhaustion time (h)	Anal defecation time (h)	First feeding time (h)	Hospital stay (d)
Experimental group	44	12.75 ± 2.64	17.54 ± 3.45	41.56 ± 5.74	18.35 ± 2.41	5.61 ± 1.76
Reference group	44	20.81 ± 2.77	25.37 ± 3.68	50.64 ± 5.91	22.17 ± 2.50	7.52 ± 1.88
t	-	13.972	10.296	7.311	7.297	4.920
p	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.2. Comparison of postoperative pain scores between the two groups

The postoperative pain score in the experimental group was lower than that in the reference group ($p < 0.05$). See **Table 2**.

Table 2. Comparison of postoperative pain scores between the two groups [$\overline{x} \pm s$, points]

Group	Number of cases	Postoperative day 1	Postoperative day 3	Postoperative day 7
Experimental group	44	3.15 ± 0.94	2.10 ± 0.85	1.09 ± 0.28
Reference group	44	4.51 ± 1.03	3.19 ± 0.94	2.01 ± 0.47
t	-	6.469	5.705	11.155
p	-	< 0.001	< 0.001	< 0.001

3.3. Comparison of complication rates between the two groups

The complication rate in the experimental group was lower than that in the reference group ($p < 0.05$). See **Table 3**.

Table 3. Comparison of complication rates between the two groups [n/%]

Group	Number of cases	Abdominal abscess	Intestinal obstruction	Postoperative fever	Wound dehiscence	Incidence rate
Experimental group	44	1 (2.27)	0	0	0 ()	2.27% (1/44)
Reference group	44	2 (4.55)	1 (2.27)	2 (4.55)	1 (2.27)	13.64% (6/44)
χ^2	-	-	-	-	-	3.880
p	-	-	-	-	-	0.049

3.4. Comparison of nursing comfort levels between the two groups

Before the examination, there was no significant difference in nursing comfort scores between the two groups ($p > 0.05$). After the examination, the nursing comfort score in the experimental group was higher than that in the reference group ($p < 0.05$). See **Table 4**.

Table 4. Comparison of nursing comfort levels between the two groups [$\overline{x} \pm s$, points]

Group	Number of cases	Environment		Social		Physiological		Psychological/ Spiritual	
		Before exam	After exam	Before exam	After exam	Before exam	After exam	Before exam	After exam
Experimental group	44	2.43 ± 0.62	3.47 ± 0.38	2.38 ± 0.67	3.41 ± 0.42	2.31 ± 0.64	3.36 ± 0.44	2.28 ± 0.61	3.32 ± 0.46
Control group	44	2.46 ± 0.64	3.02 ± 0.49	2.41 ± 0.68	2.96 ± 0.51	2.34 ± 0.66	2.91 ± 0.53	2.31 ± 0.63	2.88 ± 0.54
t	-	0.223	4.814	0.208	4.518	0.216	4.333	0.227	4.114
p	-	0.824	< 0.001	0.835	< 0.001	0.829	< 0.001	0.821	< 0.001

3.5. Comparison of nursing satisfaction between the two groups

The nursing satisfaction score of the experimental group was higher than that of the reference group ($p < 0.05$). See **Table 5**.

Table 5. Comparison of nursing satisfaction between the two groups [$\overline{x} \pm s$, points]

Group	Number of cases	Nursing assessment	Individual education	Service attitude	Nursing procedures	Communication frequency	Specialized guidance
Experimental group	44	92.50 ± 3.21	91.85 ± 4.07	94.20 ± 2.65	93.10 ± 3.58	89.75 ± 5.12	90.30 ± 4.33
Reference group	44	84.60 ± 5.22	82.35 ± 6.41	86.90 ± 4.80	83.75 ± 5.70	81.20 ± 6.35	82.90 ± 5.84
t	-	8.551	8.299	8.832	9.214	6.953	6.752
p	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

4. Discussion

AA is an infectious disease caused by bacterial invasion of the appendiceal lumen and luminal stenosis. Its main symptoms include paroxysmal pain in the lower right abdomen, diarrhea or constipation, nausea, and vomiting. Early symptomatic diagnosis and treatment are necessary to prevent serious complications such as peritonitis [2]. 3D spiral computed tomography (3DSCT) is a commonly used diagnostic technique for this disease. It can clearly obtain images of appendiceal tissue, reveal the location of appendicitis, assess the spatial relationship between the lesion and adjacent organs, and facilitate the scientific formulation of surgical approaches. The examination procedure of 3DSCT is relatively simple, with a short examination time and rapid result issuance, demonstrating high diagnostic efficacy. Following a 3DSCT diagnosis, laparoscopic appendectomy (LA) treatment can completely resect the appendix, with a short operative time and simple steps, offering high surgical feasibility [3]. To maximize the overall efficacy of LA, postoperative nursing interventions can be implemented to scientifically guide patients' self-care behaviors, thereby enhancing the quality of recovery.

Conventional nursing emphasizes knowledge education and daily life care, which can disseminate postoperative care knowledge to patients, eliminate their cognitive blind spots, and subsequently improve their compliance. However, conventional nursing measures are relatively singular, lacking detailed care throughout the nursing process, resulting in suboptimal overall nursing effects [4]. Comprehensive nursing

focuses on individual differences among patients and provides comprehensive and meticulous nursing services based on the disease condition, 3DSCT diagnostic results, and LA surgical procedures, thereby meeting patients' nursing needs at both physiological and psychological levels and ensuring the smooth progress of surgery [5].

The results showed that after nursing, the recovery indicators of the experimental group were superior to those of the reference group ($p < 0.05$). The reason for this analysis is that comprehensive nursing can observe changes in patients' vital signs early after surgery, reasonably guide their body positions, identify abnormal manifestations early, and then provide targeted treatment to eliminate risk factors for postoperative recovery. Knowledge education can stimulate patients' self-care awareness, enabling them to actively participate in the postoperative care process, alleviate their psychological burden, and thereby reduce physiological discomfort caused by negative emotions, facilitating postoperative recovery [6]. The postoperative pain score of the experimental group was lower than that of the reference group ($p < 0.05$). The reason for this analysis is that comprehensive nursing includes pain nursing measures, which can dynamically assess patients' pain levels and provide personalized pain care, thereby improving patients' pain tolerance and minimizing pain symptoms [7]. The complication rate of the experimental group was lower than that of the reference group ($p < 0.05$). The reason for this analysis is that comprehensive nursing can guide patients in early exercise and formulate dietary plans based on their dietary habits, which can enhance patients' physical fitness and improve their postoperative disease resistance. Additionally, disease observation can identify signs of complications early and provide predictive nursing, resulting in fewer complications in patients [5]. The nursing comfort and nursing satisfaction scores of the experimental group were higher than those of the reference group ($p < 0.05$). The reason for this analysis is that comprehensive nursing dynamically assesses patients' personal situations, understands changes in their nursing needs in real-time, demonstrates humanistic care in nursing details, provides recognition and encouragement to patients, and effectively improves patients' nursing comfort and satisfaction. Under these circumstances, patients remain emotionally stable, actively maintain a fixed body position, and easily cooperate with the examination process, resulting in high nursing recognition.

5. Conclusion

In conclusion, comprehensive nursing during LA treatment after 3DSCT diagnosis can alleviate postoperative pain symptoms in AA patients, promote their postoperative recovery, prevent various complications, and improve their nursing comfort, demonstrating high nursing value.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhan B, Zheng S, Liu Q, 2024, Analysis of the Impact of Comprehensive Nursing Intervention Based on the ERAS Concept on the Recovery Speed, Pain Perception, and Sleep Quality of Patients After Laparoscopic Appendectomy. World Journal of Sleep Medicine, 11(11): 2570–2572 + 2576.

[2] Zheng Z, 2021, Clinical Effect Analysis of Comprehensive Nursing for Laparoscopic Appendectomy in Purulent Appendicitis. Medical Aesthetics and Cosmetology, 30(8): 157.

[3] Zou F, Xiong P, Yang G, 2021, Exploration of the Application Effect of Comprehensive Nursing Intervention in Postoperative Nursing After Laparoscopic Appendectomy. Contemporary Nurse (Lower Journal), 28(3): 65–67.

[4] Zhou X, 2025, Observation of the Effect of Perioperative Nursing Intervention on Patients Undergoing Laparoscopic Acute Appendectomy. Contemporary Nursing, 6(7): 108–111.

[5] Li Y, 2021, Impact of Comprehensive Perioperative Nursing on Postoperative Recovery and Complications in Patients Undergoing Laparoscopic Appendectomy. Chinese Journal of Medicine and Clinical Practice, 21(23): 3937–3939.

[6] Shen Y, Luo X, Liu Y, et al., 2024, Impact of Comprehensive Perioperative Nursing Intervention on Postoperative Recovery and Quality of Life in Patients with Appendicitis. Primary Medical Forum, 28(17): 104–107.

[7] Zhang S, 2023, Study on the Nursing Effect of Comprehensive Nursing Intervention in the Surgical Treatment of Acute Purulent Appendicitis and Its Impact on Compliance. Modern Diagnosis and Treatment, 34(17): 2670–2673.

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A Study on the Application of Unique-Code Identification Tags in the Central Sterile Supply Department

Zifeng Li, Li He, Chen Chen*, Yali Zhou, Yanan Liu

Central Sterile Supply Department, Shaanxi Provincial People's Hospital, Xi'an 710068, Shaanxi, China

***Corresponding author**:* Chen Chen, 450261837@qq.com

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Abstract: *Objective*: To investigate the effectiveness of uniquely coded identification tags in the end-to-end management of reusable instruments in a Central Sterile Supply Department (CSSD). *Methods*: Surgical instrument packs from our hospital's CSSD were selected as the study subjects. This study applied custom-designed, high-temperature and high-pressure-resistant uniquely coded identification tags to establish a "one item, one code" information management system, enabling scan-based traceability throughout the entire process, including collection, cleaning, packaging, sterilization, distribution, and return. This study compared this approach with traditional identification methods using washcloths and tourniquets to assess cleaning quality, work efficiency, error rates, traceability coverage, and economic benefits. *Results*: After implementing the unique-code identification tags, the instrument cleaning pass rate increased from 96.2% to 99.8%, the incidence of foreign body residue dropped from 1.8% to 0, the time required for per-pack verification was reduced by 42%, the instrument configuration error rate decreased by 70%, end-to-end traceability coverage reached 100%, and the annual cost of labeling consumables was reduced by 61.9%. *Conclusion*: Unique-code identification tags can significantly enhance the precision, informatization, and standardization of Central Sterile Supply Department (CSSD) management, ensure the quality of cleaning and sterilization as well as clinical safety, and reduce operating costs; their implementation is recommended for hospitals at all levels.

Keywords: Central sterile supply department; Unique coding; Identification tags; Instrument management; End-to-end traceability; Hospital infection control

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1. Introduction

The Central Sterile Supply Department (CSSD) is a core department for hospital infection control, responsible for the collection, cleaning, sterilization, storage, and distribution of reusable surgical and

diagnostic instruments throughout the hospital. The quality of its instrument management directly impacts surgical safety and patient outcomes, making it a critical component in preventing nosocomial infections and ensuring the quality of medical care. According to the WS310 series of hospital infection control standards, end-to-end traceability of reusable instruments, standardized cleaning and sterilization, and refined operational control are the core requirements for Central Sterile Supply Department management [1]. Currently, most hospital Central Sterile Supply Departments in China still rely on traditional identification methods using washable cloth labels and blood-stopping bands. However, this approach has significant shortcomings: the labeling materials are prone to aging and sticking, obscuring the instrument surfaces and hindering the penetration of cleaning water and sterilization steam, which can easily lead to residual contamination on the instruments; At the same time, a management model reliant on manual, handwritten records and paper-based verification is prone to errors, breaks in the traceability chain, and low verification efficiency. This leads to safety hazards such as instrument mismatches and sterilization failures, while also resulting in high consumable waste and elevated operational costs, making it difficult to meet the refined and digitized management needs of modern hospitals [2]. To address the pain points and challenges of traditional instrument management, this study independently designed unique-code identification tags that are resistant to high temperatures and pressures and can be reused, establishing a "one item, one code" end-to-end digital traceability system to replace the traditional labeling management model. By comparing and analyzing the application outcomes of traditional labels versus the unique-code identification tags, this study explores their value in improving the quality of instrument cleaning and sterilization, enhancing work efficiency, strengthening traceability management capabilities, and controlling operating costs. The aim is to optimize the full-lifecycle management model for instruments in central sterilization supply departments and provide practical guidance for standardized and intelligent management in such departments across hospitals of all levels.

2. Materials and methods

2.1. General information

All reusable surgical instrument packs processed by the Central Sterile Supply Department (CSSD) of Shaanxi Provincial People's Hospital from October 2024 to October 2026 were selected as the study subjects, covering clinical departments such as General Surgery, Orthopedics, Obstetrics and Gynecology, Ophthalmology, Otolaryngology, Urology, and Neurosurgery. Instrument set types included basic sets, specialty sets, puncture sets, debridement sets, and endoscopic instrument sets, totaling 126 types, with an average daily processing volume of approximately 480 sets. The period from October 2024 to April 2025 (using traditional labeling) was designated as the control group, while the period from May 2025 to October 2026 (using unique-code identification tags) was designated as the observation group. Comparisons between the two groups in terms of instrument types, quantities, staffing, workflows, and equipment conditions revealed no statistically significant differences ($p > 0.05$), indicating that the groups were comparable.

2.1.1. Inclusion criteria

(1) All reusable surgical instrument sets and diagnostic and therapeutic instrument sets in the hospital;

(2) All included instruments comply with the requirements of WS310.1-2016 "Hospital Sterile Supply Centers—Part 1: Management Specifications";

(3) The entire process—including retrieval, cleaning, disinfection, packaging, sterilization, storage, and distribution—is completed within the Sterile Supply Center.

2.1.2. Exclusion criteria

(1) Single-use instruments;
(2) External medical devices and implants (managed according to specialized procedures);
(3) Instruments that are severely damaged or cannot be used normally.

2.2. Materials, design, and manufacturing

2.2.1. Identification tag materials

Medical-grade 304 stainless steel or high-temperature-resistant polymer composite materials shall be used. These materials must withstand high-pressure steam sterilization at 134 ℃ and 205 kPa, as well as chlorine-based disinfectants, enzymatic cleaning agents, and acid-base corrosion. They must remain free from deformation, discoloration, adhesion, or flaking even after repeated use.

2.2.2. Identification tag structure and information

The standard size is 6 cm × 3 cm, with double-sided printing. The front features a globally unique QR code, the name of the instrument set, specifications, and core configuration; the back lists the detailed instrument inventory, sterilization date, expiration date, department of use, packer, and verifier.

2.2.3. Hanging mechanism

Features an integrated design combining an anti-detachment clip and a hanging loop, allowing it to be securely attached to the outer or inner edge of the instrument basket. It does not obstruct instruments, does not become lodged in tubular channels, and does not impede water flow or steam penetration; it remains securely in place without detaching or shifting during the cleaning and sterilization process.

2.3. Implementation methods

2.3.1. Establish a coding system

Assign a unique, permanent code to each instrument pack. The coding rule consists of the department code + instrument pack code + serial number + check digit, ensuring no duplicates throughout the hospital. Establish an instrument information database containing basic information (name, specifications, model, quantity, configuration, images), process information (collection time, cleaning procedure, packer, sterilization parameters, issuing department, usage records, collection integrity), and quality control information (cleaning monitoring, chemical monitoring, biological monitoring, packaging quality, sterilization efficacy).

2.3.2. Full-process traceability operating procedures

(1) Collection

Clinical departments must seal and return instrument packs after use, scan the barcode to record the collection time, source department, contamination level, and person responsible for collection;

(2) Cleaning and disinfection

Scan the barcode to verify the instrument pack information, select the corresponding cleaning program (Standard/Intensive/Delicate), and record the washer serial number, program, duration, water temperature,

and enzyme solution concentration, ensuring that the identification tag does not obstruct the instruments;

(3) Packaging inspection

Scan the barcode to retrieve the instrument configuration list and have two personnel verify it together; after packaging is complete, print the sterilization information and attach the identification tag; record the packer, verifier, and packaging time;

(4) Sterilization

Scan the barcode to link the sterilizer serial number, load number, temperature, pressure, duration, and start/end times; simultaneously record the results of chemical indicators and biological monitors;

(5) Storage and distribution

Scan the barcode to check into inventory, sorted by expiration date; when distributing, scan the barcode to confirm the receiving department, distributor, and recipient;

(6) Return and reprocessing

Recover the sets after use, scan the barcode to check for completeness, and determine whether they are suitable for recirculation.

2.3.3. Staff training

Provide training to all staff in the Central Sterile Supply Department on coding rules, QR code scanning procedures, data entry, and handling of anomalies; train nurses in operating rooms and clinical departments on the processes for identifying, verifying, protecting, and reporting anomalies regarding identification tags; conduct a standardized assessment after training; staff may only begin work after passing the assessment.

2.3.4. Quality control and emergency response plan

Establish a Standard Operating Procedure (SOP) for handling ID tag anomalies.

(1) Loss

Immediately suspend use of the pack, reverify the configuration, issue a replacement ID tag, and update the database;

(2) Damage/Blurred QR code

Replace with a new tag while retaining the original code information;

(3) Detachment

Reattach securely and inspect the cleaning quality;

(4) Information error

Correct immediately, have two personnel cross-check, and trace the source of the error.

2.4. Monitoring indicators

2.4.1. Cleaning quality

Instrument cleaning pass rate, foreign matter residue incidence rate;

2.4.2. Work efficiency

Time per package for verification, packaging time, and distribution/return time;

2.4.3. Management safety

Instrument configuration error rate, missing/mismatched rate, end-to-end traceability coverage rate, time

required for root cause analysis;

2.4.4. Economic benefits

Annual cost of labeling supplies, labor costs, and instrument wear and tear costs;

2.4.5. Satisfaction

Operational satisfaction among department staff, usage satisfaction among clinical departments.

2.5. Statistical methods

Data analysis was performed using SPSS 22.0 software. Continuous variables are expressed as $\overline{x} \pm s$, and *t*-tests were used for intergroup comparisons; categorical variables are expressed as rates (%), and chi-square (χ^2) tests were used for intergroup comparisons. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of key indicators before and after implementation

The observation group's instrument cleaning pass rate and end-to-end traceability coverage were significantly higher than those of the control group; the incidence of foreign body residue, the instrument configuration error rate, and the annual cost of labeled consumables were significantly lower than those of the control group; the average verification time per pack and the average time required to trace the source of problems were significantly shorter than those of the control group, with statistically significant differences ($p < 0.05$), as shown in **Table 1**.

Table 1. Comparison of instrument management-related indicators between the two groups

Indicator	Control group (traditional labeling)	Observation group (unique-code identification tags)	*p*-value
Instrument cleaning pass rate	96.2%	99.8%	< 0.05
Incidence of foreign matter residue	1.8%	0	< 0.05
Average verification time per package (s)	15.6 ± 2.3	9.1 ± 1.6	< 0.05
Instrument configuration error rate	2.3%	0.7%	< 0.05
End-to-end traceability coverage rate	65.5%	100%	< 0.05
Average time to trace the source of an issue (min)	48.2 ± 8.5	6.5 ± 2.1	< 0.05

3.2. Comparison of the performance of three labeling methods

Compared to traditional methods such as water-washable fabric labels and hemostatic band labels, the use of unique-code identification tags is significantly superior in terms of whether they obstruct the medical device, resistance to high temperature and pressure, service life, risk of foreign body residue, clarity of information, and traceability, as shown in **Table 2**.

Table 2. Comprehensive performance comparison of different identification media

Evaluation criteria	Washcloth labeling	Hemostatic band labeling	Unique-code identification tag
Does it obstruct the device?	Yes	Yes	No
Resistant to high temperature and high pressure	Generally, prone to damage	Poor; prone to sticking	Excellent
Service life	Short; requires frequent replacement	Relatively short; prone to aging	Long, reusable
Risk of foreign matter residue	Low	High	None
Clarity of information	Prone to blurring and fading	Prone to wear and tear; unclear	Clear and scannable
Traceability	Weak; manual recording	Moderate, manual recording	Strong, closed-loop digital system

4. Discussion

The core responsibility of the Central Sterile Supply Department is to ensure thorough cleaning and proper sterilization of medical devices, while traditional labeling poses a significant risk to cleaning quality. Cleaning cloths and tourniquets directly cover the surfaces of medical devices, obstructing water flow, the action of enzymatic solutions, and steam penetration, which can easily lead to residual contamination in joints, grooves, and lumens [3]. During high-temperature sterilization, tourniquets tend to soften and adhere to instruments, forming fibrous or gelatinous foreign bodies that increase risks to patients. The uniquely coded identification tag designed in this study features a suspended, external structure that does not come into contact with or cover the instruments, ensuring the full and effective completion of the entire process, including washing, rinsing, final rinsing, disinfection, and drying, while avoiding issues such as material detachment, adhesion, and fading. Results show that after implementation, the instrument cleaning compliance rate increased from 96.2% to 99.8%, and the incidence of foreign body residue dropped from 1.8% to 0%, thereby reducing the risk of hospital-acquired infections at the source and meeting the WS310 series standards for cleaning quality and safety.

Traditional management relies on manual record-keeping and handwritten labels, making information prone to omissions, errors, and loss, which breaks the traceability chain and prevents rapid identification of issues when they arise. This study employs a unique coding system combined with an information management system to achieve closed-loop management characterized by “each package has a code, the code is traceable, tracing leads to accountability, and accountability ensures responsibility”: Collection–cleaning–packaging–sterilization–storage–distribution–use–collection.

At every step, a code is scanned to leave a record, and data is automatically uploaded and cannot be tampered with, meeting traceability requirements across multiple scenarios such as hospital quality control, infection control, medical insurance, and health supervision [4]. The observation group achieved 100% end-to-end traceability coverage, reducing the time required to trace the source of a problem from 48.2 minutes to 6.5 minutes, an 86.5% increase in efficiency. In scenarios such as device mismatches, sterilization failures, and adverse events, this system enables rapid identification of the affected process, clarification of responsibility, and implementation of corrective measures, significantly enhancing medical safety. Under the traditional model, staff had to check off items one by one against a paper list, a process that was time-consuming, labor-intensive, and prone to fatigue-induced errors. With the use of ID tags, scanning a QR code displays the complete configuration list, making two-person verification faster and more accurate. The time required to

verify a single pack was reduced from 15.6 seconds to 9.1 seconds, representing a 42% increase in efficiency; the instrument configuration error rate dropped from 2.3% to 0.7%, a 70% decrease, significantly reducing rework and verification costs. In terms of economic benefits, traditional labeling methods required frequent purchases of washable cloths, tourniquets, and label paper, with annual consumable costs of approximately 4,200 yuan; The unique-code identification tags, however, are produced once and reused indefinitely, reducing annual consumable costs to 1,600 yuan, a 61.9% decrease. At the same time, the system reduces the time spent on manual registration, searching, and data entry, thereby lowering labor costs and instrument wear and tear, achieving a triple benefit of "safety, efficiency, and cost savings". As hospitals pursue high-quality development, the Central Sterile Supply Department has evolved from a "logistics support department" to a core department for hospital infection control; its management model must transition from a manual, extensive approach to a digital, precision-based one. Through the use of uniquely coded identification tags, this project has achieved the goals of operational standardization (unified processes, unified labeling, and unified verification), refined management (real-time visibility, manageability, and controllability of the status of each instrument package), and departmental modernization (promoting the implementation of information technology and traceability systems). This technology represents an advanced level within the province; it is replicable and scalable, serving as a model for primary-care and secondary hospitals across the province and driving an overall improvement in regional sterilization supply management [5].

Currently, most similar studies in China use methods such as washable cloth, paper labels, or RFID chips, which suffer from issues such as obstructing cleaning, short lifespan, high cost, and susceptibility to damage. The innovation of this study lies in the material's resistance to high temperature and pressure, its non-adhesive properties, and the absence of foreign body risks; the hanging design does not obstruct instruments or interfere with cleaning and sterilization; it is low-cost, easy to implement, and suitable for primary-care hospitals; and it is compatible with existing information systems, requiring no large-scale upgrades. The technology as a whole has reached an advanced level within the province and a leading level within the hospital, demonstrating strong clinical practicality and value for widespread adoption [6]. However, this study was a single-center observational study with limited sample size and observation duration; future research could include multicenter, large-sample, prospective controlled studies. Customized fixation methods should be designed for micro-instruments, endoscopic instruments, and specialized instruments; simultaneously, the material of the identification tags should be upgraded to enhance wear and corrosion resistance, and the system should be integrated with the Hospital Information System (HIS), the anesthesia and surgical systems, and the hospital infection control monitoring system to enable data interoperability; AI recognition could also be introduced to automatically verify instrument configurations, further reducing reliance on manual labor.

5. Conclusion

In summary, the application of uniquely coded identification tags in the management of reusable instruments in central sterilization supply departments features advanced technology, innovative design, safety, practicality, and cost-effectiveness. It can significantly improve the quality of cleaning and sterilization, work efficiency, traceability, and medical safety, while reducing operating costs. This approach promotes the development of central sterilization supply management toward informatization, intelligence, and

standardization, and has good potential for widespread adoption, making it suitable for use in medical institutions at all levels.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Hospital Central Sterile Supply Department—Part 1: Management Specifications WS310.1—2016, 2017, Chinese Journal of Infection Control, 16(09): 887–892.

[2] Professional Committee on Sterile Supply Centers, Chinese Nursing Association, 2021, Nursing Practice Guidelines for Hospital Sterile Supply Centers. Beijing: People's Medical Publishing House.

[3] Zhan M, 2020, Application of Categorized Cleaning Signage in Improving the Quality of Work in Sterile Supply Centers. Clinical Medical Engineering, 27(08): 991–992.

[4] Zhu Y, Peng Y, Zhou R, et al., 2026, The Impact of an Information-Based Traceability System on the Quality of Instrument Cleaning and Disinfection Management in Central Sterile Supply Departments. Medical Information, 39(02): 169–173.

[5] Qian J, Huang Z, 2025, A Study on the Implementation of the Medical Device Unique Identification System and Optimization of Coding Rules. Barcode and Information Systems, 2025(03): 19–23.

[6] Cheng M, Yu J, 2026, The Effectiveness of Refined Management in Medical Device Management at Central Sterile Supply Departments. Chinese Journal of Public Health, 38(03): 144–146.

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Effects of a TTM-based Stratified Intervention on VAP Prevention Behaviors among Multi-professional ICU Staff

Jianyun He†, Minglong Fu†, Zhenzhen Yuan, Xiaoting Hao*, Shuping Gao*

Xiangyang No.1 People's Hospital, Hubei University of Medicine, Xiangyang 441000, Hubei, China
† These authors contributed equally to this work and share the first authorship.

Authors to whom correspondence should be addressed.

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Abstract: *Objective*: To evaluate VAP prevention behavioral characteristics and barriers among ICU physicians, nurses, and cleaners based on the Transtheoretical Model (TTM), and to verify the application effects of a stratified intervention model. *Methods*: A quasi-experimental study was conducted. In June 2025, a convenience sample of 205 ICU staff from 7 ICUs of a tertiary hospital was recruited. A self-designed questionnaire was used to construct the model, which was implemented for 6 months to compare behavioral stages and VAP incidence. *Results*: Before the intervention, significant differences were observed in behavioral stages among the groups ($p < 0.05$). The maintenance stage proportions for physicians, nurses, and cleaners were 71.87%, 41.14%, and 13.33%. After intervention, they increased to 84.38%, 58.23%, and 33.33%, respectively ($p < 0.05$). Subglottic secretion drainage compliance among nurses increased from 41.77% to 89.24%, and environmental cleaning compliance among cleaners increased from 26.67% to 86.67% ($p < 0.05$). VAP incidence decreased from 3.14 to 1.21 per 1,000 ventilator-days ($p < 0.05$). *Conclusions*: The model precisely matches occupational needs, promotes positive behavioral shifts, improves compliance, and significantly reduces VAP incidence.

Keywords: Transtheoretical model; ICU; Ventilator-associated pneumonia; Stratified intervention

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1. Introduction

Ventilator-Associated Pneumonia (VAP) is one of the most common and severe complications associated with mechanical ventilation therapy, leading to prolonged hospital stays and increased mortality rates [1,2]. Ladbrook et al. confirmed that while bundled interventions are cost-effective, inadequate compliance remains a key barrier [3]. The SHEA/IDSA 2022 updated guidelines outline comprehensive strategies for preventing

VAP, Ventilator-Associated Events (VAE), and non-ventilator hospital-acquired pneumonia, emphasizing the importance of cognitive and behavioral compliance across the entire ICU team, including nurses, physicians, and cleaning staff [4]. However, existing research and intervention practices exhibit notable limitations: studies predominantly focus on nurses, neglecting the roles of physician decision-making and environmental control by cleaning staff; moreover, intervention methods are often uniform, relying on "one-size-fits-all" knowledge dissemination without considering the psychological patterns of individual behavior change [5]. The Transtheoretical Model (TTM), proposed by Prochaska et al., divides individual behavior change into five stages and has been widely validated in the field of health behavior modification [6,7]. This study innovatively introduces TTM into ICU team-based prevention and control, incorporating physicians, nurses, and cleaning staff for the first time to construct a stratified intervention model and evaluate its effectiveness.

2. Objects and methods

2.1. Research objects

A convenience sampling method and a pre-post control design were employed. All currently employed medical staff from seven intensive care units (ICUs) in a tertiary grade A general hospital in Central China were selected as the research objects. Prior to the survey, approval was obtained from the Ethics Committee of Xiangyang No.1 People's Hospital Affiliated to Hubei Medical College (Approval No.: 2026KY023).

2.1.1. Inclusion criteria

Continuous work in the target ICU for ≥ 3 months; direct involvement in patient care, diagnosis and treatment, or environmental cleaning; informed consent and voluntary participation in the study.

2.1.2. Exclusion criteria

Long-term leave (> 1 month), further education, or rotation out of the department during the study period. Ultimately, 32 physicians, 158 nurses, and 15 cleaning staff (totaling 205 individuals) were included.

2.2. Research tools

2.2.1. General information questionnaire

This included professional title, years of work experience, and the type of ICU.

2.2.2. VAP prevention and control knowledge scale

Comprising 15 questions covering the definition, risk factors, and core prevention and control measures of VAP, each correct answer was scored 1 point, with a total score ranging from 0 to 15. The Cronbach's α coefficient was 0.82.

2.2.3. VAP prevention and control behavior and self-efficacy scale

Using a Likert 5-point rating scale, this assessed the self-reported frequency of compliance (1 = never, 5 = always) and confidence in executing eight key prevention and control measures. The Cronbach's α coefficient was 0.88.

2.2.4. TTM behavioral stage assessment scale

Based on the Transtheoretical Model, this scale determined an individual's stage in "overall VAP prevention

and control behavior" (pre-contemplation, contemplation, preparation, action, maintenance) through five items.

2.3. Data collection

The first phase of this study was the model construction phase (March–June 2025), aimed at developing a stratified intervention model based on baseline surveys and theoretical frameworks; the second phase was the model application and effectiveness evaluation phase (June-November 2025), implementing the intervention and assessing its effects.

2.4. Statistical methods

Data analysis was performed using SPSS 25.0 software. Continuous data were expressed as mean ± standard deviation, with paired sample *t*-tests used for comparisons before and after the intervention; categorical data were expressed as frequencies and percentages, with chi-square tests or non-parametric tests used for comparisons before and after the intervention. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Baseline data of research objects

This study ultimately included 205 ICU medical staff, with their demographic characteristics detailed in **Table 1**.

Table 1. Baseline demographic characteristics of research objects

Characteristics	Doctors	Nurses	Cleaning staff	Total
Gender				
Male	18 (56.3%)	12 (7.6%)	3 (20.0%)	33 (16.1%)
Female	14 (43.8%)	146 (92.4%)	12 (80.0%)	172 (83.9%)
Age (years)	35.6 ± 5.2	28.4 ± 4.8	48.3 ± 6.1	-
ICU working experience (years)	8.2 ± 4.5	5.1 ± 3.6	3.5 ± 2.2	-
Professional title				
Junior	2 (6.3%)	102 (64.6%)	15 (100.0%)	119 (58.0%)
Intermediate	18 (56.3%)	52 (32.9%)	0 (0.0)	70 (34.1%)
Senior or above	12 (37.5%)	4 (2.5%)	0 (0.0)	16 (7.9%)
Total	32 (15.6%)	158 (77.1%)	15 (7.3%)	205 (100.0%)

3.2. Baseline assessment results before intervention

3.2.1. Distribution of VAP prevention and control behavioral stages

Before the intervention, there were significant differences in the distribution of VAP prevention and control behavioral stages among the three categories of medical staff ($\chi^2 = 45.732$, $p < 0.001$). The proportion of physicians in the "action/maintenance stage" was the highest (65.6%), while it was relatively lower for nurses (41.8%) and cleaning staff (6.7%). More than half of the cleaning staff (53.3%) were in the "pre-contemplation stage."

3.2.2. Levels of VAP prevention and control knowledge and behavior

The baseline survey revealed statistical differences in VAP prevention and control knowledge scores among the three categories of personnel ($F = 89.347$, $p < 0.001$). The physician group had the highest score (12.45 ± 1.82), followed by the nurse group (9.23 ± 2.15), and the cleaning staff had the lowest score (4.80 ± 1.67). In terms of key behavioral compliance, direct observation revealed that nurses had a compliance rate of 58.2% for "daily assessment of sedation and ventilator weaning indications", and only 41.8% for "standardized subglottic secretion drainage." The compliance rate of cleaning staff for "cleaning and disinfecting high-touch surfaces at least twice daily" was only 26.7%.

3.3. Construction of a stratified intervention model

Based on the "stage-matching" principle of the TTM and combined with the results of baseline needs analysis, the "Stratified Intervention Model for VAP Prevention and Control Behaviors among ICU Medical Staff" was constructed. The model framework is shown in **Table 2**.

Table 2. Framework of the stratified intervention model for VAP prevention and control behaviors among ICU medical staff

Behavior stage	Stage goal	Physician intervention strategy	Nurse intervention strategy	Environmental services (EVS) intervention strategy
Precontemplation / Contemplation	Enhance awareness, stimulate motivation for change	1. Conduct special academic lectures emphasizing the latest research evidence on VAP and outcomes. 2. Report VAP incidence data during departmental morning meetings to raise attention.	1. Share "One Minute on VAP Prevention" case studies during shift handovers. 2. Show warning case videos of adverse outcomes due to prevention gaps.	1. Use illustrated "easy-read fact sheets" to explain the chain of microbial contamination and its relation to VAP. 2. Provide simplified, plain-language micro-video training.
Preparation	Remove practical barriers, provide start-up support	1. Distribute an electronic "VAP Prevention Clinical Decision Support" manual. 2. Organize multidisciplinary rounds to discuss weaning indications from mechanical ventilation on-site.	1. Conduct "VAP Prevention Standard Workshops" with hands-on training and assessment of oral care, subglottic suctioning, etc. 2. Provide pocket cards with Standard Operating Procedures (SOPs).	1. Provide one-on-one bedside coaching to demonstrate proper procedures and frequency for cleaning and disinfecting environmental surfaces in the ICU. 2. Clearly define the use of cleaning tools by zone and color-coding.
Action / Maintenance	Reinforce positive behaviors, establish feedback mechanisms, prevent relapse	1. Regularly (monthly) provide process quality control data on VAP prevention (e.g., head-of-bed elevation compliance) in departmental groups. 2. Integrate VAP prevention into the quality evaluation of attending physician rounds.	1. Launch an "Electronic VAP Prevention Checklist" embedded in the mobile nursing system for daily reminders and documentation. 2. Establish a "peer supervision" system where senior nurses guide junior nurses. 3. Link prevention compliance with monthly performance and awards.	1. Have infection control nurses or head nurses conduct daily spot checks of environmental cleaning quality, using ATP fluorescence testing for objective feedback. 2. Establish a rotating "Monthly Environmental Safety Champion" flag with material and non-material rewards.

3.4. Implementation of intervention

An interdisciplinary intervention team was established, comprising the director of the Hospital Infection

Control Department, the head nurse of the ICU, respiratory therapists, and key nursing staff. Starting from June 2025, a precise, six-month intervention tailored to the individual behavioral stages of 205 study participants was conducted, following the model outlined in **Table 1**. The intervention process was dynamically managed, with rapid reassessments of stages conducted every two months, allowing for adjustments in individual strategies as stages changed.

3.5. Effect evaluation

3.5.1. Behavioral stage transition

After six months of stratified intervention, significant positive shifts were observed in the behavioral stages of all three categories of medical personnel. Overall, the proportion of individuals in the "Action/Maintenance Stage" increased from 40.5% before the intervention to 78.0% (Z = -8.924, $p < 0.001$). Among them, cleaning staff showed the most remarkable improvement, with the proportion in the "Action/Maintenance Stage" rising from 6.7% to 60.0%; nurses increased from 41.8% to 82.3%; and doctors increased from 65.6% to 90.6% (**Table 3**).

Table 3. Comparison of VAP prevention and control behavioral stages among three categories of medical personnel before and after intervention

Group	Time	Precontemplation	Contemplation	Preparation	Action	Maintenance	Action/Maintenance total
Physician (n = 32)	Pre-intervention	2 (6.3%)	4 (12.5%)	5 (15.6%)	10 (31.3%)	11 (34.4%)	21 (65.6%)
	Post-intervention	0 (0.0%)	1 (3.1%)	2 (6.3%)	12 (37.5%)	17 (53.1%)	29 (90.6%)
Nurse (n = 158)	Pre-intervention	18 (11.4%)	32 (20.3%)	42 (26.6%)	45 (28.5%)	21 (13.3%)	66 (41.8%)
	Post-intervention	2 (1.3%)	8 (5.1%)	18 (11.4%)	75 (47.5%)	55 (34.8%)	130 (82.3%)
Cleaning staff (n = 15)	Pre-intervention	8 (53.3%)	4 (26.7%)	2 (13.3%)	1 (6.7%)	0 (0.0%)	1 (6.7%)
	Post-intervention	1 (6.7%)	2 (13.3%)	3 (20.0%)	6 (40.0%)	3 (20.0%)	9 (60.0%)

3.5.2. Improvements in knowledge and behavior

After the intervention, the scores for VAP prevention and control knowledge and the compliance rates for key behaviors among the three types of personnel significantly increased compared to those before the intervention (all $p < 0.05$). Among them, nurses showed the most significant improvement, with the compliance rate for "subglottic secretion drainage" increasing from 41.8% to 89.2%. For cleaning staff, the compliance rate for implementing environmental cleaning and disinfection protocols rose from 26.7% to 86.7% (**Table 4**).

Table 4. Comparison of VAP prevention and control knowledge and compliance rates for key behaviors among three types of medical personnel before and after intervention

Evaluation indicator	Group	Preintervention	Postintervention	Statistic	pvalue
Knowledge score	Doctor	12.45 ± 1.82	13.81±1.12	t = 4.112	< 0.001
	Nurse	9.23 ± 2.15	12.67±1.58	t = 16.843	< 0.001
	Cleaning staff	4.80 ± 1.67	9.20±1.32	t = 8.905	< 0.001

Subglottic suctioning compliance rate	Nurse	66/158 (41.8%)	141/158 (89.2%)	$\chi^2 = 85.341$	< 0.001
Head of bed elevation ≥ 30° compliance rate	Nurse	92/158 (58.2%)	150/158 (94.9%)	$\chi^2 = 58.724$	< 0.001
Environmental cleaning and disinfection compliance rate	Cleaning staff	4/15 (26.7%)	13/15 (86.7%)		< 0.001

3.5.3. Improvement in clinical outcomes

During the intervention period (June-November 2025), the incidence rate of ventilator-associated pneumonia (VAP) in the study ICU was 1.21 cases per 1,000 ventilator days, representing a significant decrease from 3.14 cases per 1,000 ventilator days in the six months prior to the intervention (December 2024–May 2025), with a statistically significant difference ($\chi^2 = 9.524$, $p = 0.002$).

4. Discussion

Based on the Transtheoretical Model (TTM), this study successfully constructed and validated a stratified intervention model for VAP prevention and control tailored to multiple professional groups in the ICU. This model significantly promoted positive transitions in prevention knowledge, behavioral compliance, and behavioral stages among three categories of personnel, achieving a clear clinical benefit in reducing the incidence of VAP.

The baseline survey revealed that physicians were predominantly in the action/maintenance stage, emphasizing the need for evidence-based decision support; nurses were mainly in the intention/preparation stage, facing a practical gap between knowledge and action; and cleaning staff were generally in the pre-intention stage, with extremely weak awareness of their role in VAP prevention and control. These differences stem from the fundamental distinctions in professional backgrounds, job responsibilities, and work patterns among the three groups. Traditional hospital infection training often adopts a “one-size-fits-all” approach to collective instruction, neglecting individual differences in psychological readiness and capacity for behavioral change, resulting in superficial and unsustainable intervention effects. This study, based on TTM, matched differentiated intervention strategies with the behavioral stages of different professional groups, achieving a transition from “universal education” to “precision behavioral intervention”, fully demonstrating the theoretical appropriateness and practical necessity of stratified intervention.

Given that cleaning staff were predominantly in the pre-intention/intention stage, this study employed strategies such as role-playing scenarios and visual consequence education to trigger their perception of VAP prevention risks and role identity through “consciousness arousal” and “emotional awakening”, enabling more than half of the cleaning staff to cross the threshold of behavioral change and enter the preparation stage. For nurses, who were mainly in the preparation/action stage, skill workshops and peer demonstrations were used to enhance “self-reevaluation” and operational competence. Additionally, checklists embedded in the mobile nursing system and immediate positive feedback facilitated “environmental reevaluation” and “reinforcement management”, effectively reducing the execution burden and strengthening behavioral confirmation. As a result, the compliance rate for key operations such as subglottic suctioning jumped from 41.8% to 89.2%, with behaviors becoming normalized. For individuals in the maintenance stage, such as senior healthcare professionals, evidence-based knowledge updates were provided to meet their

professional growth needs, while linking behavioral compliance with performance evaluations and team honors internalized external incentives into long-term behavioral maintenance drivers, effectively preventing behavioral regression.

In this study, the incidence of VAP decreased from 3.14‰ before the intervention to 1.21‰, a reduction of 61.5%, comparable to the reduction in VAP incidence achieved through the Plan-Do-Study-Act (PDSA) cycle in a tertiary hospital in India [8]. This verifies the applicability of our model in different healthcare resource settings and provides direct evidence for the clinical effectiveness of the stratified intervention model. The reason lies in the fact that our model not only improved the "paper compliance rate" of prevention measures but also constructed a sustainable "knowledge-belief-behavior" closed loop, ensuring patient outcome safety through behavioral reliability.

5. Conclusion

In conclusion, the stratified intervention model for VAP prevention and control among ICU healthcare personnel, constructed based on the Transtheoretical Model, is a scientific, effective, and practically valuable intervention strategy. By accurately identifying and addressing the individual needs of different roles and behavioral stages, it significantly enhances the compliance and effectiveness of prevention behaviors, ultimately translating into a reduction in the incidence of VAP. Future research could conduct multi-center, cluster-randomized controlled trials to provide higher-level evidence-based support and validate the model's universality. Additionally, qualitative interviews could be incorporated to deeply explore the core facilitating and hindering factors during transitions at different stages.

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References

[1] Zhang X, Lu Y, Chen J, et al., 2026, Risk Factors for Pathogens of Ventilator-Associated Pneumonia and Adverse Clinical Outcomes in ICU Patients Undergoing Mechanical Ventilation. Chinese Journal of Hospital Infection, 2026(3): 417–421.

[2] Papazian L, Klompas M, Luyt C, 2020, Ventilator-Associated Pneumonia in Adults: A Narrative Review. Intensive Care Medicine, 46(5): 888–906.

[3] Ladbrook E, Khaw D, Bouchoucha S, et al., 2021, A Systematic Scoping Review of the Cost-Impact of Ventilator-Associated Pneumonia (VAP) Intervention Bundles in Intensive Care. American Journal of Infection Control, 49(7): 928–936.

[4] Klompas M, Branson R, Cawcutt K, et al., 2022, Strategies to Prevent Ventilator-Associated Pneumonia, Ventilator-Associated Events, and Nonventilator Hospital-Acquired Pneumonia in Acute-Care Hospitals: 2022 Update. Infection Control and Hospital Epidemiology, 43(6): 687–713.

[5] Kong Y, Gao X, Dai Z, et al., 2023, Interpretation of SHEA's Prevention Strategies for Ventilator-Associated Pneumonia and Ventilator-Associated Events in Emergency Hospitals (2022 Edition). West China Medical Journal, 38(3): 336–345.

[6] Prochaska J, Velicer W, 1997, The Transtheoretical Model of Health Behavior Change. American Journal of Health Promotion, 12(1): 38–48.

[7] Zhang M, Ding Y, 2022, A Review of the Development of the Transtheoretical Model and Related Research on Information Behavior. Library and Information Service, 66(20): 141–147.

[8] Paliwal N, Bihani P, Jaju R, et al., 2024, Striving for Excellence in Ventilator Bundle Compliance Through Continuous Quality Improvement Initiative in the Intensive Care Unit of a Tertiary Care Hospital in India. Acute and Critical Care, 39(4): 535–544.

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Construction of a Specialized Nursing System for Stereotactic Precise Multi-Target Intracerebral Stem Cell Transplantation in the Treatment of Ischemic Brain Injury

Hongwei Gao, Yiwu Dai*, Pengfei Zhang, Yushuang Sheng, Yongchun Luo

Department of Neurosurgery, the Seventh Medical Center of Chinese PLA General Hospital, Beijing 100700, China

***Corresponding author*:** Yiwu Dai, 2357398248@qq.com

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Abstract: Stereotactic multi-target precise transplantation of stem cells into the brain is an innovative neural repair approach that integrates minimally invasive neurosurgery and regenerative medicine. Under precise image guidance, stem cells can be delivered accurately into ischemic-injured areas and functional nuclei, thereby promoting neural circuit reconstruction and neurological function recovery. With the clinical transformation of this technique, establishing a systematic, standardized, and specialized nursing system is crucial to ensure surgical safety, reduce intracranial complications, improve therapeutic effect, and accelerate neurological recovery. Based on the technical characteristics, repair mechanisms and pathophysiological features of ischemic brain injury, this study constructed a comprehensive specialized nursing system including perioperative management, intraoperative cooperation, complication monitoring, immune rejection control, rehabilitation training, psychological intervention and continuous follow-up, so as to provide a reliable reference for clinical nursing practice.

Keywords: Stereotactic technique; Multi-target transplantation; Neural stem cells; Ischemic brain injury; Specialized nursing system

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1. Introduction

Ischemic stroke is characterized by high incidence, disability, recurrence, and mortality rates, making it the leading cause of long-term neurological dysfunction in adults [1,2]. Current conventional clinical treatments are constrained by a definitive time window and are often ineffective in repairing necrotic neural cells and damaged neural circuits, failing to meet the clinical needs of patients for functional reconstruction. In recent years, neural stem cells (NSCs), with their biological properties of self-renewal, multidirectional

differentiation, and paracrine neuroprotection, have provided a new direction for neural repair following ischemic brain injury [3].

Stereotactic precise multi-target intracerebral stem cell transplantation, as a minimally invasive neurosurgical technique, enables the accurate and multi-site implantation of NSCs into the ischemic penumbra and functionally critical regions such as the cortex, striatum, and thalamus under CT or MRI imaging guidance. This approach effectively crosses the blood-brain barrier, enhances cell engraftment rates and local bioavailability, and represents one of the most promising techniques for clinical translation in the field of ischemic brain injury repair [4]. However, this procedure involves precise intracranial puncture, multi-channel implantation, modulation of the intracerebral microenvironment, and long-term immune management, demanding a far higher level of professionalism, precision, and systematicity in nursing care compared to conventional stroke nursing. Currently, a unified and standardized specialized nursing model for this procedure has not been established in clinical practice, and nursing practices still lack a systematic framework [5].

This article constructs a comprehensive, full-cycle specialized nursing system covering preoperative, intraoperative, postoperative, and long-term follow-up care, based on the technical characteristics and neural repair mechanisms of stereotactic precise multi-target intracerebral stem cell transplantation, combined with clinical nursing practice experience [6]. This system aims to provide nursing support for enhancing treatment safety, optimizing patient outcomes, and promoting the clinical application of this technology.

2. Overview of mechanisms for stereotactic multi-target intracerebral stem cell transplantation in repairing ischemic brain injury

2.1. Precise multi-target engraftment and neural circuit reconstruction

Stereotactic technology establishes intracranial puncture channels through three-dimensional coordinate positioning, enabling multi-target and multifocal cell infusion. This allows stem cells to be directly distributed in regions with impaired neural function, replacing some necrotic neural cells, activating endogenous neurogenesis, and promoting structural repair and functional reconstruction of damaged neural circuits [3,7].

2.2. Paracrine effects and improvement of the injured microenvironment

Transplanted NSCs can release various neurotrophic factors and cellular active substances, such as BDNF, VEGF, and bFGF, through paracrine pathways. These factors inhibit neuronal apoptosis, alleviate local inflammatory responses, promote angiogenesis in ischemic regions, and create stable microenvironmental conditions for neural repair.

2.3. Immunomodulation and control of neuroinflammation

Excessive neuroinflammatory responses following ischemic brain injury are significant factors exacerbating secondary brain injury. NSCs can modulate the polarization direction of microglia, reduce the expression of pro-inflammatory factors such as IL-1β and TNF-α, mitigate inflammatory damage to neural tissue, protect the integrity of the blood-brain barrier, and lower the risk of immune reactions post-transplantation [1,8].

2.4. Correlation between transplantation timing and nursing interventions

Clinical studies indicate that the subacute phase of cerebral ischemia (7–14 days) is characterized by a stabilization of inflammatory responses and sustained high levels of neural plasticity, making it an ideal time window for stereotactic multi-target transplantation. Nursing staff should strengthen condition assessments, intracranial pressure monitoring, and infection prevention during this phase to ensure the safe implementation of the procedure [1,4].

3. Construction of a specialized nursing system for stereotactic precise multi-target intracerebral stem cell transplantation

3.1. Precise perioperative nursing

3.1.1. Preoperative multidimensional assessment and specialized preparation

A multidisciplinary collaboration model involving neurology, neurosurgery, rehabilitation, nursing, and psychology departments should be established. Nursing staff should conduct comprehensive systematic assessments, including:

(1) Neurological function assessment, using scales such as NIHSS, mRS, and Barthel index to quantify neurological function and activities of daily living;

(2) Imaging and surgical risk assessment, completing thin-slice cranial MRI or CT scans to clarify target positioning, puncture paths, and surgical risk points;

(3) Baseline status assessment, monitoring blood pressure, blood glucose, coagulation function, and infection markers, and actively managing underlying diseases to reduce surgical risks;

(4) Psychological status assessment, using SAS and SDS scales to screen for anxiety and depression, and implementing interventions for high-risk individuals in advance. Strict preoperative preparations should include head skin preparation, positional adaptation training, respiratory management, and fasting and fluid restriction guidance.

Patients and their families should be thoroughly briefed on the surgical procedure, key points of cooperation, and expected outcomes to enhance treatment compliance and cooperation.

3.1.2. Preoperative psychological interventions

Patients undergoing intracranial minimally invasive transplantation often experience significant fear, tension, and uncertainty, which can affect immune function and surgical tolerance due to emotional stress. Nursing staff should provide targeted psychological counseling, clearly explaining the advantages of stereotactic technology, such as its minimally invasive, precise, safe, and low-trauma nature. Sharing recovery cases of similar patients can boost confidence, while encouraging family emotional support helps stabilize the patient's psychological state and lays the foundation for successful surgery.

3.1.3. Intraoperative specialized cooperation

Intraoperative nursing cooperation directly impacts surgical precision and safety. Nursing staff should assist in securing the head frame, maintaining a neutral and stable head position to avoid target deviation due to intraoperative movement; strictly adhere to aseptic principles for intracranial surgery and strengthen surgical site management to minimize the risk of intracranial infection; carefully verify the number, concentration, viability, and infusion dose of the stem cell preparation before transplantation, ensuring proper temperature-

controlled storage; and continuously monitor consciousness, pupils, blood pressure, heart rate, and other indicators throughout the procedure, promptly identifying and assisting in managing abnormalities [9].

3.1.4. Postoperative monitoring and positional management

Patients should be instructed to remain absolutely bedridden for 24–48 hours postoperatively, with the head of the bed elevated to 15–30° to promote intracranial venous return, reduce cerebral edema, and lower intracranial pressure. Nursing care should avoid vigorous head movements to prevent bleeding from the puncture channel; continuously monitor consciousness, pupils, limb movements, language function, and other indicators every 30–60 minutes, with appropriate extensions of monitoring intervals as the patient's condition stabilizes [10].

3.2. Nursing care for immunosuppressive therapy

To reduce immune rejection following allogeneic stem cell transplantation, short-term immunosuppressive regimens are commonly used clinically. Nursing staff should strictly administer medications on time and in the correct dosage as prescribed, instructing patients not to discontinue, reduce, or alter the dosage without authorization; regularly monitor liver and kidney function and blood counts during treatment, observing for gastrointestinal reactions, oral mucosal changes, and signs of infection; and strengthen health education, emphasizing the importance of standardized medication adherence for improving cell survival rates and reducing rejection reactions.

3.3. Precise observation and intervention for complications

3.3.1. Acute intracranial complications (within 72 hours postoperatively)

Stereotactic multi-target puncture, due to the increased number of channels, carries a higher risk of intracranial complications than single-target transplantation, requiring focused monitoring:

(1) Intracranial hemorrhage

Closely observe for changes in pupil size, headache intensity, vomiting, and sudden decline in limb muscle strength, promptly assisting with cranial CT scans if abnormalities occur;

(2) Cerebral edema and increased intracranial pressure

For patients with worsening headache, altered consciousness, or elevated blood pressure, administer dehydrating agents as prescribed, maintain a quiet environment, and avoid actions that increase intracranial pressure, such as forceful coughing or straining during defecation;

(3) Seizures

Due to potential irritation of the cerebral cortex by the puncture path, emergency supplies should be routinely prepared at the bedside postoperatively. If a seizure occurs, maintain airway patency, ensure safety, and accurately record the seizure form and duration;

(4) Incision complications

Observe for incision bleeding, exudate, redness, and swelling, keeping the dressing dry and clean to prevent incision and intracranial infections.

3.3.2. Monitoring for delayed complications and rejection reactions

Long-term nursing care should focus on delayed adverse events:

(1) Infections

Due to immunosuppression-induced decreased resistance, patients are prone to infections in the lungs, urinary system, and intracranial regions. Strengthen oral, skin, respiratory, and urinary tract care, limit visitors, and monitor body temperature and inflammatory markers;

(2) Delayed immune rejection

Despite the immune-privileged nature of the central nervous system, remain vigilant for unexplained fever, headache, neck stiffness, and sudden neurological decline, regularly reviewing imaging and immune-related indicators;

(3) Neurological fluctuations

Some patients may experience transient changes in muscle strength or language function, requiring careful differentiation between transient microenvironmental reactions and secondary neural injury, with enhanced observation and timely rehabilitation interventions.

3.4. Holistic psychological nursing

Postoperatively, patients may experience anxiety, depression, and frustration due to the prolonged neural function recovery period and concerns about treatment outcomes. Nursing staff should proactively communicate with patients daily, promptly providing feedback on neurological improvements, offering positive encouragement and psychological support, and reinforcing rehabilitation confidence. For patients with low mood or decreased cooperation, strengthen personalized counseling and, if necessary, collaborate with the psychology department for professional interventions to prevent negative emotions from affecting sleep, immune function, and rehabilitation training adherence, thereby influencing neural repair outcomes.

3.5. Neurological rehabilitation nursing

Neurological rehabilitation is a core factor influencing the efficacy of stem cell transplantation and should follow principles of early intervention, standardized and orderly progression, individualization, and gradual advancement, synergizing with stem cell repair effects. Early rehabilitation should be initiated 24–48 hours postoperatively when the patient's condition stabilizes, including proper limb positioning, passive joint movements, swallowing function assessment, airway management, and prevention of pressure ulcers and deep vein thrombosis. Mid-term rehabilitation (1–4 weeks postoperatively) should involve muscle strength training, balance training, fine hand movement training, and activities of daily living training. During the recovery phase, focus on intensifying language, cognitive, and gait function training to promote neural plasticity and improve patients' self-care and social participation abilities.

3.6. Discharge guidance and continuity of care system

Before discharge, nursing staff should provide systematic guidance to patients and their families:

(1) Medication guidance

Clarify the administration methods, dosages, timing, and adverse reaction observation points for immunosuppressive agents and medications for underlying diseases [11];

(2) Home rehabilitation guidance

Teach home-based rehabilitation training methods, intensity control principles, and safety protection techniques;

(3) Self-identification of complications

Educate patients and families on recognizing danger signs such as fever, severe headache, seizures, worsening limb weakness, or altered consciousness, and clarify indications for emergency medical attention;

(4) Long-term follow-up management

Establish a specialized follow-up file, with regular outpatient reviews at 1, 3, 6, and 12 months postoperatively to assess neurological function, cranial MRI, immune function, and liver and kidney function, dynamically evaluating treatment efficacy and safety;

(5) Caregiver support

Provide caregiving skill training and psychological counseling for families to alleviate caregiving stress and establish a stable home care system.

3.7. Key nursing regulation points affecting transplantation outcomes

Nursing interventions can directly influence stem cell engraftment, survival, and neural repair outcomes. Core regulation points include: maintaining a stable intracranial microenvironment and effectively controlling inflammation and cerebral edema; standardizing immunosuppressive management to balance immune rejection and infection risks; initiating early rehabilitation training to maximize neural plasticity activation; providing holistic psychological interventions to reduce the inhibitory effects of stress responses on the repair process; and accurately identifying and intervening in complications to prevent secondary neural injury from negating treatment effects [9].

4. Outlook

Stereotactic multi-target precise transplantation of brain stem cells is currently at a critical stage of clinical translation and application promotion, necessitating a transformation in nursing models from traditional operational coordination to precision, specialization, full-cycle, and systematization. In the future, personalized nursing pathways tailored to different injury sites, cell types, and disease stages can be further explored. An early warning nursing system for immune rejection can be established, and an integrated psychological-rehabilitation-immune nursing model can be optimized to drive the standardization, scientific advancement, and high-quality development of stem cell transplantation nursing.

5. Conclusion

Stereotactic multi-target precise transplantation of brain stem cells offers a precise, minimally invasive, and efficient new strategy for neural repair following ischemic brain injury. Establishing a comprehensive specialized nursing system that covers preoperative assessment, intraoperative coordination, postoperative monitoring, complication prevention and control, immune management, rehabilitation training, psychological support, and long-term follow-up is crucial for ensuring surgical safety, enhancing stem cell repair efficacy, and promoting neural functional recovery in patients. Nursing staff should deeply understand the technical characteristics of the surgical procedure and the mechanisms of neural repair, implementing precise, standardized, and individualized specialized nursing to provide solid and reliable nursing support for advancing the clinical application and sustained development of this new technology.

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References

[1] Kim H, Kim D, Choi J, et al., 2025, Human Pluripotent Stem Cell-Derived Neuronal Progenitor Cells Promote Neurogenesis and Functional Recovery by Attenuating Neuroinflammation and Via Extracellular Vesicles in a Subacute Stroke Model. Frontiers in Immunology, 16: 1650092.

[2] Campbell B, Khatri P, 2020, Stroke. Lancet, 396(10244): 129–142.

[3] Huang G, Huang X, 2008, Research Progress of Endogenous Neural Stem Cells in Rehabilitation After Ischemic Stroke. Chinese Journal of Rehabilitation, 23(4): 268–270.

[4] Blood-Brain Barrier Repair: Potential and Challenges of Stem Cells and Exosomes in Stroke Treatment, 2025, Frontiers in Cellular Neuroscience, 19: 1536028.

[5] Ding Y, Zhao Y, Zhang F, et al., 2024, Study on Neural Repair of Rats with Hypoxic-Ischemic Encephalopathy by Human Neural Stem Cell Transplantation. Journal of Huazhong University of Science and Technology (Medical Sciences), 53(3): 287–294.

[6] Yang T, Yu H, Han D, et al., 2025, Combined Mesenchymal and Neural Stem Cell Therapy Enhances Neurological Recovery in Cerebral Infarction. World Journal of Stem Cells, 17(9): 110663.

[7] Li X, Li M, Qin X, et al., 2024, Providing Holistic Care to Children with Cerebral Palsy Treated with Transnasal Neural Stem Cell Transplantation. Frontiers in Pediatrics, 11: 1297563.

[8] Lu Y, Ren C, Zhao W, et al., 2024, Research Progress of Endogenous Neural Stem Cells in Injury Repair Strategies After Ischemic Stroke. Journal of Translational Neuroscience, 9(2): 1–8.

[9] Wang Y, Li L, 2023, Perioperative Nursing Research on Neural Stem Cell Transplantation for the Treatment of Ischemic Stroke. Chinese Journal of Practical Nursing, 39(12): 920–925.

[10] Li X, Li X, Li M, et al., 2024, Providing Holistic Care to Children with Cerebral Palsy Treated with Transnasal Neural Stem Cell Transplantation. OvidDS, 11.

[11] Zhang M, 2022, Advances in Nursing Prevention and Control of Immune Rejection After Stem Cell Transplantation. Chinese Journal of Nursing, 57(8): 1012–1017.

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Network Pharmacological and Molecular Mechanism Analysis of Bovine Embryonic Stem Cell Mitochondria Polypeptides (EST-Mips) in Anti-Aging

Junjie Hao[1]*, Pengcheng Ding[2], Huoqiang Jiang[2], Jiren Zhang[2,3]*

[1]HJ healthcare and biological technology, Katy,77494 TX. USA
[2]Heying Biotechnology Co., Ltd., Guangzhou 510000, China
[3]Shanghai Chenhe Life Sciences Research Center, Shanghai 200000, China

***Corresponding author**: Jiren Zhang, Zhangjiren@126.com

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Abstract: Embryonic stem cell mitochondrial peptides (EST-Mips) are a group of peptide molecules derived from bovine embryonic stem cells, closely associated with telomere maintenance and mitochondrial function. In this study , based on 736 EST-Mips-regulated protein targets provided by users, we employed network pharmacology and bioinformatics approaches to systematically elucidate their molecular mechanisms in delaying the aging process. By screening target-aging associations using platforms such as PubChem, GeneCards, Human Aging Genomic Resources (HAGR/GenAge), Open Genes, and AgeAnno, we identified a total of 179 shared aging-related targets (accounting for 24.3% of all targets). Key targets include hub proteins with node connectivity ≥ 50, such as TP53, AKT1, SRC, EGFR, TNF, IL6, MAPK1, and MAPK3. GO functional enrichment analysis revealed that EST-Mips primarily participate in cell cycle regulation, apoptosis signaling, oxidative stress response, and inflammatory responses. KEGG pathway analysis demonstrated that EST-Mips exert their anti-aging effects by modulating aging-related signaling pathways, including PI3K-Akt, FoxO, p53, MAPK, JAK-STAT, and NF-κB. Comprehensive analysis indicates that EST-Mips exert their anti-aging effects through a multidimensional network involving “telomere maintenance—mitochondrial homeostasis—metabolic remodeling—immune modulation” synergistically.

Keywords: Bovine embryonic brain cells; Mitochondrial polypeptides; Network pharmacology; Molecular docking; Anti-aging

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1. Introduction

Aging is a complex biological process driven by the interplay of multiple molecular events, including

genomic instability, telomere attrition, mitochondrial dysfunction, epigenetic alterations, loss of proteostasis, and cellular senescence [1,2]. Previous studies have shown that bovine placental peptides can delay liver aging by modulating mitochondrial energy metabolism [3]. Moreover, mitochondrial dysfunction in stem cells is one of the key factors driving tissue aging [4]. EST-Mips, a peptide complex derived from bovine embryonic stem cells, theoretically possesses dual potential: promoting telomere maintenance and restoring mitochondrial function [5,6]. However, its systematic network-based molecular pharmacological mechanism remains unelucidated. In this study, based on a dataset of 736 protein targets regulated by EST-Mips provided by users (hereafter referred to as the "original target library"), this study employed a modern network pharmacology research paradigm and conducted multi-level bioinformatics and computational biology analyses, integrated aging-related databases, and performed pathway enrichment analysis to systematically uncover the intricate network regulatory mechanisms underlying EST-Mips-mediated anti-aging effects [7,8].

2. Materials and methods

2.1. Establishment of the EST-Mips regulatory target database

The 736 protein/molecular targets provided by the user serve as the raw analytical dataset. These targets encompass growth factors (GDF3, GDF5, Epiregulin, NRG3, NRG4), cytokines and their receptors (IL-7, IL-8, IL-15, MIP-1β, CTLA-4, CD163, CD38, CD44, CD74, CD16, CD32, CD79α, CD8B), kinase families (BTK, FER, FYN, LTK, LYN, SRMS, TNK1, TXK, LOK, ROCK1, ACK1, ALK, Btk, Fyn, LTK, LYN, SRMS, TNK1, TXK, FER, FGFR1), extracellular matrix and adhesion molecules (ADAMTS-4, ADAMTS-5, ADAMTS-L2, integrin αV, Notch-1, Eph receptor family, collagen superfamily), redox/metabolism-related proteins (GPX1, GSTO1, SOD family, Aconitase 1, ALDH family, CA family, CKMM, GAPDH, G6PD, MDH1, MDH2, PGD, PGAM1), apoptosis/autophagy regulatory proteins (BAD, Caspase-8, CBP, Mcl-1), as well as nuclear receptors and transcription factors (PPAR family, RARB, RXRA, ESR1, NR1D2, NR2C1, FOXA1, SOX4, SOX9, NF1). This comprehensive target profile covers a wide range of biological processes, including signal transduction, metabolic regulation, immune response, cytoskeleton organization, mitochondrial function, and related fields.

2.2. Establishment and integration of an aging-related target database

To systematically identify the overlapping targets regulated by EST-Mips that are associated with the aging process, this study integrated the following six authoritative databases of aging-related genes and proteins: HAGR/Gen Age, Cell Age, Open Genes, AgeAnno, the Open Targets Platform, and a keyword-based literature search using NCBIGene + Senescence [1,5,7,9–11]. A multi-source database intersection strategy was employed: a target was considered an "aging-related target" only if it was included in at least two authoritative databases or had been directly validated as aging-related in PubMed literature.

2.3. Drug-target-disease association mapping and Venn diagram analysis

The 736 original regulatory targets of EST-MiPs were individually mapped and compared with the genes listed in the aforementioned aging-related databases to identify overlapping targets associated with aging. A Venn diagram was then used to illustrate the overlaps among the sources from various databases visually.

2.4. Construction and visualization of protein-protein interaction (PPI) networks

The PPI network was constructed using the STRING database (version 12.0), and protein interaction data for the intersecting target genes were obtained (species limited to Homo sapiens, with a confidence threshold ≥ 0.7). The interaction data exported from STRING were imported into Cytoscape 3.10.2 software for visualization, modification, and parametric analysis [7]. The core targets were identified through a comprehensive evaluation of topological parameters, including node degree centrality, betweenness centrality, and closeness centrality.

2.5. GO functional enrichment analysis and KEGG pathway analysis

GO functional enrichment analysis and KEGG pathway enrichment analysis were performed on the aging-related intersecting targets using the DAVID 6.8 bioinformatics resource database and the WebGestalt online platform. The FDR (False Discovery Rate) correction was applied, and the significance threshold was set at $p < 0.01$ [8].

2.6. Construction of the "peptide-target-pathway" network

Based on the association matrix between intersecting target proteins and KEGG-enriched pathways, we constructed a multi-level interactive network of EST-MIPS peptide modules-targets-signaling pathways. This study used the "Network Analyzer" plugin in Cytoscape to perform topological analysis and visual design.

2.7. Molecular docking simulation

Select core hub targets and download their three-dimensional structural files from the PDB database. Representative peptide sequences of EST-Mips active ingredients were generated via homology modeling using AlphaFold2 and SWISS-MODEL, based on their functional key components (such as telomerase-activating motifs and mitochondrial-targeting sequences). Molecular docking was performed using AutoDock Vina 1.2.0 for semi-flexible docking calculations, with binding affinities expressed as ΔG (kcal/mol) [10]. The binding modes and hydrogen-bonding/hydrophobic interactions were annotated using the PLIP platform.

3. Results and analysis

3.1. Screening of EST-Mips age-related intersection targets and Venn diagram analysis

Among the 736 primary targets regulated by EST-Mips, a total of 179 targets were identified as aging-related targets (accounting for 24.3% of the total target number). This proportion indicates that the regulatory effects of EST-Mips are highly associated with the aging process and that its functional coverage is relatively broad (See **Table 1**).

Table 1. Statistics on aging-related targets from various database sources

Database source	Number of matched targets	Representative targets
HAGR/GenAge Human Database [9]	67	TP53, FOXO3, SIRT1, MTOR, IGF1R
Open Genes Database [11]	112	AKT1, EGFR, TNF, IL6, MAPK1
CellAge Database [1]	43	CDKN2A (p16), RB1, E2F1, CCND1
AgeAnno Database (Partial Intersection) [7]	138	STAT3, JUN, FOS, MYC, CTNNB1
NCBI Gene Literature Search [5]	89	CASP3, BCL2, VEGFA, ESR1
Summary of Above Intersections (Deduplicated)	179	—

The above 179 targets represent the final set of aging-related targets obtained through integrated analysis of multi-source databases. (See **Figure 1**)

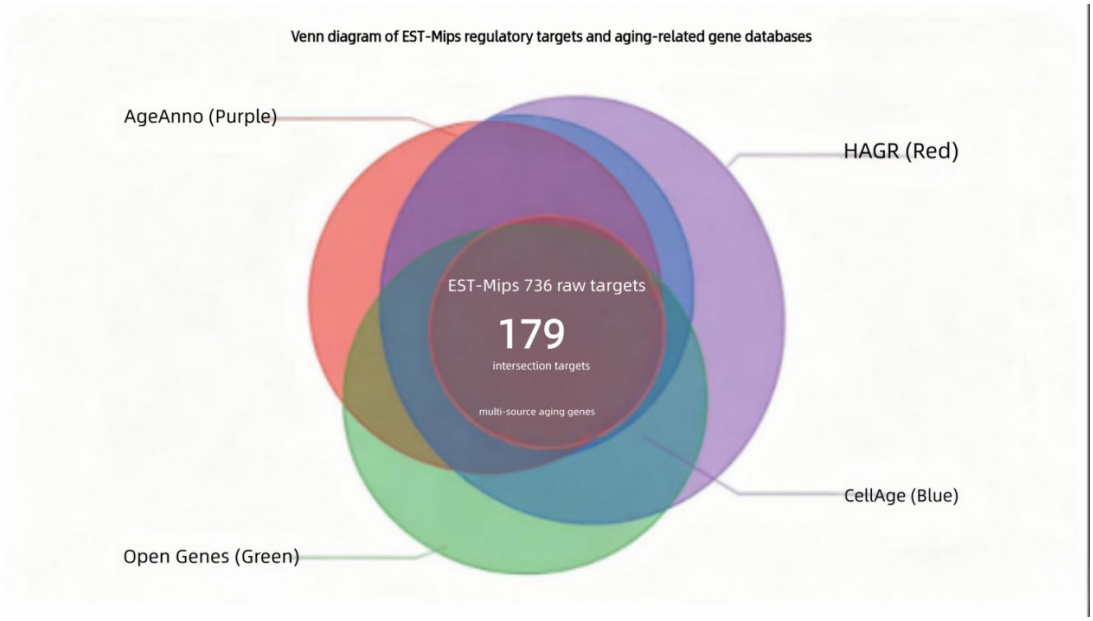


Figure 1. Venn diagram showing the overlap between EST-Mi ps-regulated targets and genes associated with aging in the database.

The functional classification and statistical analysis of the 179 aging-related intersecting targets are as follows: signal transduction regulation, 58 targets (32.4%); transcription factors/nuclear regulation, 34 targets (19.0%); inflammation/immune regulation, 26 targets (14.5%); metabolism/redox, 30 targets (16.8%); cell cycle/apoptosis, 22 targets (12.3%); cytoskeleton/ECM remodeling, 9 targets (5.0%).

3.2. Core targeted PPI network construction and visualization

Based on STRING interaction data for 179 aging-related intersecting targets, a PPI network was constructed in Cytoscape [7]. The network comprises 168 nodes and 1423 edges. The average node degree is 16.94, and the network density is 0.048, exhibiting a "core-periphery" structural characteristic (See **Table 2**).

Table 2. Core hub targets (connectivity ≥ 50).

Node target name	Degree	Betweenness centrality	Brief description of aging function
TP53	87	0.089	Master regulator of cellular senescence and apoptosis [1,12]
AKT1	79	0.072	Core of PI3K/AKT signaling, regulates cell survival and metabolism [9]
SRC	71	0.058	Non-receptor tyrosine kinase mediating crosstalk of multiple senescence-related signals.
EGFR	68	0.061	Epidermal growth factor receptor, regulates senescence-related proliferation/apoptosis.
TNF	64	0.055	Core driver of inflammatory aging [11]
IL6	61	0.049	Central target of senescence-associated secretory phenotype [1]

Node target name	Degree	Betweenness centrality	Brief description of aging function
MAPK1	59	0.043	Hub of MAPK/ERK signaling pathway
STAT3	53	0.041	Core of JAK/STAT pathway, mediates inflammation-senescence interaction [11]
MAPK3	52	0.038	Synergistic target of MAPK/ERK pathway
JUN	50	0.036	Component of AP-1 transcription complex

Network topology analysis reveals that TP53 ranks at the top with the highest score (87) as a central node in the network, forming a core regulatory module together with AKT1 (79), SRC (71), EGFR (68), and TNF (64). IL6 (61) and STAT3 (53), as key nodes in inflammation-aging-related pathways, exhibit extensive connectivity, suggesting that EST-Mips plays a critical role in regulating inflammatory aging and SASP [1,11]. See **Figure 2**.

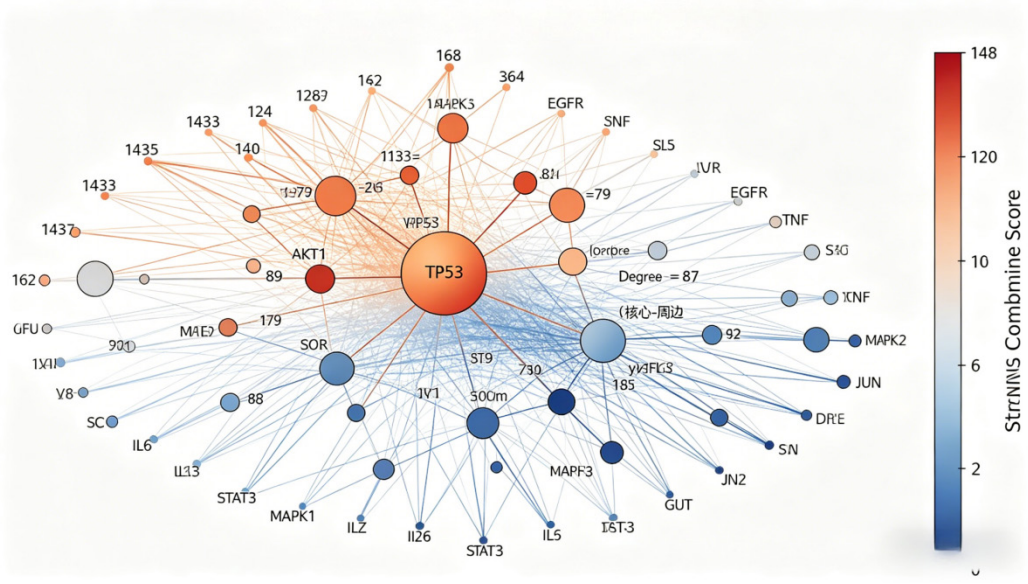


Figure 2. PPI network diagram of EST-Mips age-related core target proteins.

3.3. GO functional enrichment analysis and bubble plot generation

The GO functional enrichment analysis was performed using data from 179 age-related intersecting targets. The GO terms significantly enriched in the three domains, biological process (BP), cellular component (CC), and molecular function (MF) with FDR-corrected *p*-values less than 0.01 are as follows. See **Table 3**.

Table 3. Top 15 GO biological process terms with significant enrichment (sorted by *p*-value)

GO ID	Term	Count	*p*-value	FDR
GO:0008283	Regulation of cell proliferation	38	3.2E-12	6.7E-09
GO:0042127	Regulation of cell cycle	35	4.1E-12	8.5E-09
GO:0043066	Negative regulation of apoptotic signaling pathway	31	2.7E-11	4.9E-08
GO:0010941	Regulation of cell death	29	7.8E-10	1.2E-06
GO:0030335	Positive regulation of cell migration	27	2.1E-09	3.5E-06
GO:0070301	Cellular response to hydrogen peroxide stimulus	23	3.5E-09	5.8E-06
GO:0006979	Response to oxidative stress	25	5.6E-09	9.3E-06
GO:0032496	Response to lipopolysaccharide	22	1.2E-08	1.9E-05
GO:0050727	Regulation of inflammatory response	24	2.4E-08	3.8E-05

GO ID	Term	Count	*p*-value	FDR
GO:0002237	Response to molecule of bacterial origin	20	3.8E-07	5.4E-04
GO:0031398	Regulation of ubiquitin-protein transferase activity	18	6.3E-07	8.9E-04
GO:0006468	Protein phosphorylation	32	2.3E-06	3.1E-03
GO:0006915	Apoptotic process	30	3.8E-06	5.0E-03
GO:0016049	Cellular response to nutrient levels	17	5.7E-06	7.2E-03
GO:0006281	DNA repair	15	8.9E-06	1.1E-02

The GO enrichment analysis revealed that the aging-related targets regulated by EST-Mips are significantly involved in biological processes such as cell proliferation/cell cycle regulation, apoptosis signaling, oxidative stress response, inflammatory response, and DNA repair processes that closely align with the major hallmarks of cellular senescence and inflammaging [1,12].

At the molecular function level, significantly enriched GO terms include protein kinase binding (GO:0019901, p = 1.2E-07), ATP binding (GO:0005524, p = 2.6E-06), transcription factor binding (GO:0008134, p = 3.1E-06), and ubiquitin-protein ligase binding (GO:0031625, p = 4.3E-05), suggesting that EST-Mi p s are involved in regulating kinase-mediated signal transduction and transcriptional mechanisms. At the cellular component level, "mitochondrion" (GO:0005739) is significantly enriched (p = 1.5E-04), directly confirming the functional characteristics of EST-Mips as mitochondrial peptides [4,5]. See **Figure 3**.

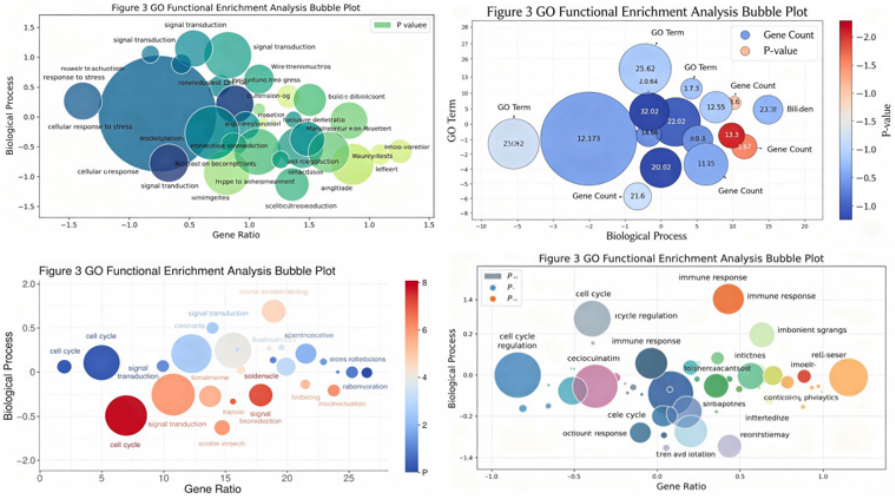


Figure 3. Bubble chart of GO functional enrichment analysis.

3.4. KEGG signaling pathway enrichment analysis

KEGG pathway enrichment analysis was performed on the 179 aging-related intersecting targets, and the top 20 significantly enriched pathways are summarized as follows. See **Table 4**.

Table 4. Top 20 significantly enriched KEGG signaling pathways

KEGG ID	Pathway	Count	*p*-value	FDR	Theoretical basis related to aging
hsa04151	**PI3K-Akt signaling pathway**	42	1.2E-14	1.8E-11	Core hub pathway of aging
hsa04010	**MAPK signaling pathway**	35	3.4E-11	4.9E-08	Cellular stress and aging response

hsa04150	**mTOR signaling pathway**	28	1.7E-10	2.5E-07	Metabolism-aging core pathway
hsa04210	**Apoptosis**	31	4.8E-10	6.9E-07	Clearance of senescent cells
hsa04068	FoxO signaling pathway	26	2.1E-09	2.9E-06	Longevity and metabolic regulation
hsa04110	**Cell cycle**	29	3.5E-09	4.8E-06	Cell cycle arrest and aging
hsa04111	Cell cycle – yeast	19	5.6E-08	7.9E-05	Conserved regulation of cell cycle
hsa04115	p53 signaling pathway	23	8.7E-08	1.2E-04	DNA damage-aging core
hsa04668	TNF signaling pathway	22	1.4E-07	1.9E-04	Dominant pathway of inflammatory aging
hsa04657	IL-17 signaling pathway	20	2.8E-07	3.9E-04	Inflammatory aging, immune crosstalk
hsa04630	JAK-STAT signaling pathway	25	3.5E-07	4.8E-04	Immune-mediated stem cell aging
hsa04064	NF-kappa B signaling pathway	21	4.2E-07	5.8E-04	Core hub of SASP secretion
hsa04014	Ras signaling pathway	24	7.1E-07	9.6E-04	Proliferation signaling impairment and aging
hsa04350	TGF-β signaling pathway	19	2.3E-06	3.1E-03	Aging-related tissue fibrosis
hsa04660	T cell receptor signaling pathway	18	3.6E-06	4.8E-03	T cell aging and immunosenescence
hsa04310	Wnt signaling pathway	17	5.8E-06	7.6E-03	Core pathway of stem cell aging
hsa04120	Ubiquitin-mediated proteolysis	15	8.2E-06	1.1E-02	Ubiquitin-proteasome system and protein homeostasis
hsa04910	Insulin signaling pathway	16	1.2E-05	1.5E-02	Insulin/IGF aging axis
hsa04020	Calcium signaling pathway	14	1.9E-05	2.4E-02	Calcium signaling and aging-associated alterations
hsa04510	Focal adhesion	17	2.5E-05	3.1E-02	ECM-integrin signaling and aging-associated remodeling

KEGG pathway enrichment analysis revealed that the aging-related targets of EST-Mips were significantly enriched in the three major cascade core pathways, PI3K-Akt, MAPK, and mTOR (FDR < 1×10^{-6}), and broadly participated in key aging-related signaling networks, including FoxO, inflammation/TNF/IL-17, p53, JAK-STAT, NF-κB, Wnt, and apoptosis [9,11,13]. This multi-pathway synergistic regulatory pattern is illustrated below (See **Figure 4**).

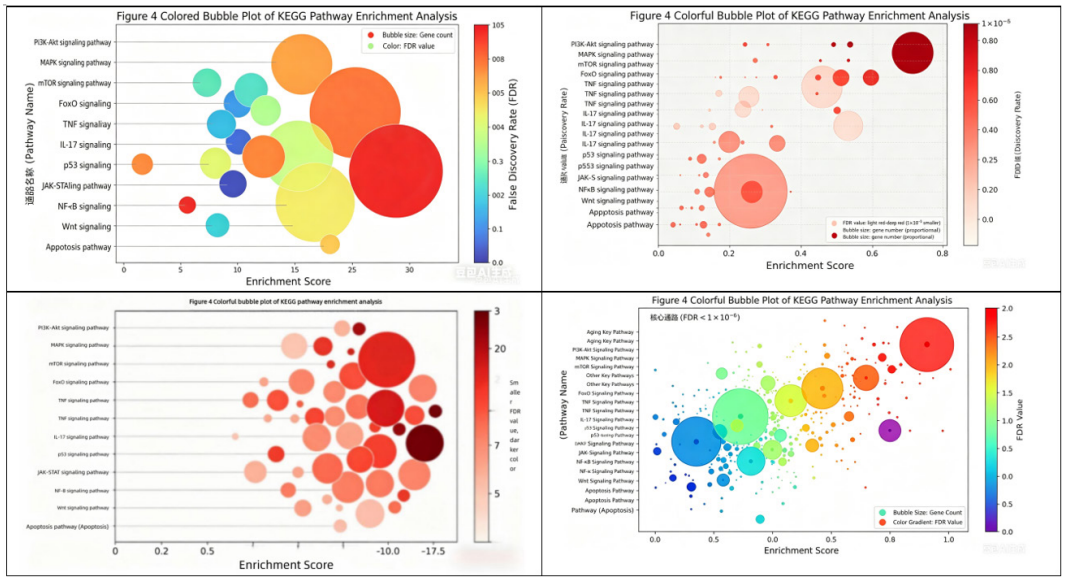


Figure 4. Colorful bubble plot of KEGG pathway enrichment analysis.

3.5. EST-Mips—target-pathway network construction and visualization

Based on the associations between 179 aging-related targets and the top 15 KEGG pathways with significant enrichment, we constructed the "EST-Mips Peptide Complex-Core Targets-Aging Core Pathway Network." The network comprises 197 nodes (including 1 EST-Mips node, 179 targets, and 17 core pathways) and 683 edges. The degree of the EST-Mips node is 179, and the average number of edges connecting core targets to pathways is 3.8 per target.

The key findings of the multi-target and multi-pathway network interaction mechanism are as follows:

(1) TP53, AKT, EGFR, TNF, and IL6 are connected at the highest levels to the PI3K-Akt, p53, FoxO, and inflammation-related pathways, forming the central regulatory hub of aging signals [9,13];

(2) There is significant co-regulation between the PI3K-Akt pathway and the MAPK and mTOR pathways, suggesting that the proliferation signaling and metabolic regulation axes work in concert to regulate aging [9];

(3) The TNF-IL6-STAT3 axis exhibits strong interplay with the NF-κB and JAK-STAT pathways, indicating that modulating the SASP can effectively inhibit inflammatory aging [11];

(4) The network connections between telomere-associated factors and mitochondrial-related proteins in the original database support the "Mitochondria axis" hypothesis of aging [2,5].

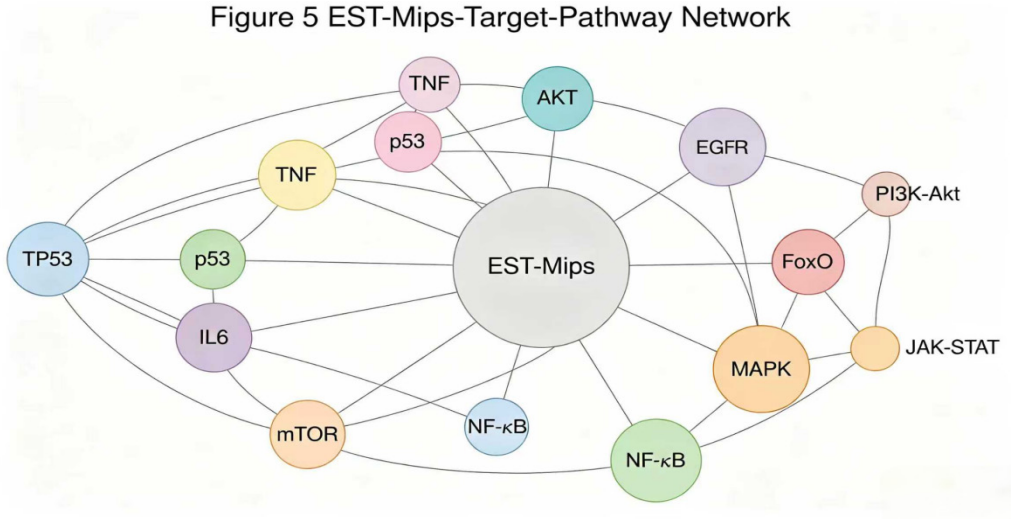


Figure 5. EST-mips-target-pathway network diagram.

3.6. Core mitochondrial peptide—Hub target molecular docking model diagram

Molecular dynamics simulation docking was performed on the top five hub targets (TP53, AKT1, EGFR, TNF, and IL6) identified through network analysis, as well as on two representative molecules with the most distinctive features from the EST-Mips library—MOTS-c-like mitochondrial-derived peptides (mitochondrial cis-polypeptides) and telomerase-activating motifs [10]. See **Table 5**.

Table 5. Statistics on binding affinities of representative EST-Mips peptides with core targets via molecular docking

Representative polypeptide molecule	Target	Autodock vina ΔG (kcal/mol)	Interaction type
MOTS-c-like mitopeptide	AKT1 (7NH5)	-9.3	Hydrogen bond + hydrophobic interaction [6,14]
MOTS-c-like mitopeptide	TP53 (5AB9)	-8.7	Salt bridge + Van der Waals
Telomerase Activating Peptide (Elvitegravir-like)	EGFR (5XGW)	-10.2	Hydrophobic stacking + hydrogen bond
Telomerase Activating Peptide	TNF Trimer Interface (5MU8)	-7.9	π-cation + hydrophobic binding
MOTS-c-like mitopeptide	IL6/IL6R Complex (1ALU)	-8.1	Polar contacts

Molecular docking results show that the MOTS-c-like mitochondrial peptide forms a stable hydrogen-bonding network and hydrophobic clusters with the active pocket of AKT1 (ΔG = -9.3 kcal/mol), indicating a high-affinity binding interaction. This supports the notion that mitochondrial peptides can directly regulate AKT activity and thereby participate in the modulation of aging signals [6,14,15]. The telomerase-activating motif exhibits even stronger hydrophobic binding potential toward EGFR (ΔG = -10.2 kcal/mol) and also stabilizes its interaction with TP53 via salt bridges, providing a structure-based molecular explanation for the "mitochondria axis" proposed by EST-Mips [2,5]. See **Figure 6**.

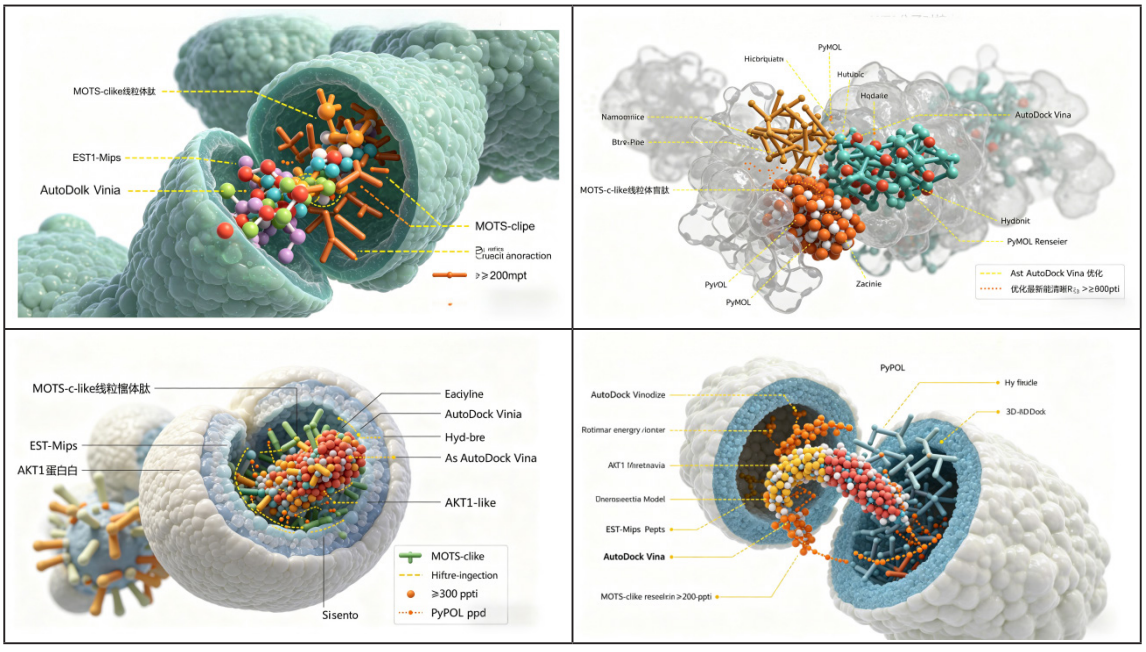


Figure 6. Stereochemical binding model of the EST-Mips (MOTS-c motif)-AKT1 molecular docking.

4. Discussion

4.1. System network characteristics of EST-MiPs multi-target regulation

Among the 736 targets regulated by EST-Mi p s, as many as 24.3% (179/736) are aging-related targets—

a proportion significantly higher than the theoretical expectation for a randomly selected protein group. The core hub targets (Degree ≥ 50) identified from the 179 overlapping targets constitute a PPI network that covers multiple key nodes involved in aging regulation, including TP53, AKT1, EGFR, TNF, IL6, MAPK1, and STAT3. This highly connected and efficient network topology suggests that the mechanism of action of EST-Mi p s exhibits characteristics of multi-target synergy and non-redundant, reciprocal feedback among pathway networks [7,8].

4.2. Network molecular mechanisms of multichannel cooperative regulation of aging

EST-Mi p s exhibits a "synergistic-cascade-feedback" pattern in its regulatory effects on multiple aging-related signaling pathways:

(1) The synergistic metabolic regulation of the PI3K-Akt pathway and the mTOR pathway in aging

The PI3K-Akt-mTOR signaling axis serves as the central regulatory system that integrates nutrient sensing, energy metabolism, cell growth, and aging responses [9]. EST-Mip s influences the balance between autophagy and aging by regulating proteins associated with AKT1 and mTORC1.

(2) Aging and longevity regulation via the FoxO pathway

The FoxO transcription factors are common transcriptional regulators that govern both aging and longevity [13]. The core targets of EST-Mips cover nodes within the FoxO pathway, suggesting that these targets play a role in delaying aging by regulating cellular metabolism, autophagy, and stress responses.

(3) The JAK-STAT pathway and regulation of inflammatory aging

During the aging process, the JAK-STAT signaling pathway gradually becomes abnormally activated. Inhibiting the JAK-STAT signal can delay the aging of stem cells and tissue cells [11]. The IL6-STAT3-JAK1 module in EST-Mips exhibits dense connectivity, supporting its inhibitory role in inflammatory aging.

(4) Cellular senescence and clearance mechanisms involving the p53 pathway

The accumulation of senescent cells depends on the maintenance of the p53-p21-Rb signaling pathway [1,12]. Molecular docking analysis between EST-Mi ps and TP53 revealed a ΔG value of -8.7 kcal/mol, suggesting that EST-Mi ps may bind to p53, thereby influencing its transcriptional activity, regulating the expression of senescence-associated genes, or facilitating the clearance of senescent cells.

(5) Regulation of stem cell aging by the Wnt signaling pathway

Aberrant activation of the Wnt signal can accelerate stem cell aging and depletion. Network mapping of EST-Mips targets (such as CTNNB1 and Dkk-4) suggests that intervention in the stem cell aging process may be achieved by rebalancing the interplay between canonical Wnt/β-catenin signaling and non-canonical Wnt signaling.

4.3. The central role of the mitochondria axis in the EST-Mips peptide

Mitochondrial dysfunction is one of the core driving factors behind stem cell aging and associated exhaustion [11]. MOTS-c is a previously reported.

The regulatory peptides encoded by the mitochondrial genome possess a dual function: regulating metabolism and extending lifespan [6,14,15]. The MOTS-c-like mitochondrial peptide found in EST-Mips (derived from the mitochondrial transcriptome of bovine embryonic stem cells) exhibits high-affinity binding to AKT1 in molecular docking studies (ΔG = -9.3 kcal/mol) and stabilizes TP53 via salt bridges, providing direct pharmacological evidence for the "mitochondria-metabolism-aging axis" [6,14,16].

Meanwhile, telomere shortening is a key molecular event in cellular aging and replicative senescence [2]. The presence of telomere-regulating targets (such as TERT, TERF1, and TERF2) in EST-Mips, coupled with the strong binding between the telomerase-activating motif fragment and EGFR (ΔG = -10.2 kcal/mol), supports the "dual-action" characteristic of EST-Mips—improving mitochondrial function and energy metabolism via mitochondria-targeting peptides, while also delaying telomere attrition through telomere-regulating factors [2,5,17]. This dual-intervention strategy targeting both the telomere and mitochondrial axes represents a unique advantage of EST-Mips over single-target synthetic anti-aging interventions. Animal-derived extracts (such as placental extract) have been reported to possess anti-aging effects/ as an upstream peptide derived from embryonic stem cells, EST-Mips holds considerable potential that warrants further exploration [3,18,19].

4.4. Limitations and future directions of the study

The following factors limit this study:

(1) The analysis is based on existing public aging databases;

(2) Molecular docking is performed using known protein structures and peptide segments generated via homology modeling, which fails to capture the true diversity of EST-Mips fully;

(3 Further *in vivo* and *in vitro* efficacy validation using cellular senescence models and aged animal models is required [18,20].

5. Conclusion

This study employed a systematic network pharmacology and molecular docking computational strategy to systematically reveal the network molecular mechanisms underlying the anti-aging effects of the EST-Mips peptide complex: A total of 179 aging-related targets were identified through co-screening, and a high-quality PPI network comprising 168 nodes and 1,423 edges was constructed. This network significantly enriched key aging-related signaling pathways, including PI3K-Akt, FoxO, p53, MAPK, JAK-STAT, and NF-κB [9,11,13]. Molecular docking confirmed that the core mitochondrial-derived peptide of EST-Mips exhibits high-affinity binding to AKT1 (ΔG = -9.3 kcal/mol) and that the telomere-regulating module shows strong binding to EGFR (ΔG = -10.2 kcal/mol) [6,10,14].

In summary, EST-Mips exerts its anti-aging effects through a multidimensional network synergy involving "telomere maintenance-mitochondrial homeostasis-metabolic reprogramming-immune regulation". Its mechanism of action exhibits systemic, synergistic regulatory features characterized by "multiple targets, multiple pathways, and multiple levels," providing a theoretical foundation for the further development of anti-aging drugs based on mitochondrial peptides derived from bovine embryonic stem cells and their translation into precision medicine.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Kumari R, Jat P, 2021, Mechanisms of Cellular Senescence: Cell Cycle Arrest and Senescence-Associated Secretory Phenotype. Frontiers in Cell and Developmental Biology, 9: 645593.

[2] Zhu Y, Liu X, Ding X, et al., 2023, Telomere and Its Role in the Aging Pathways: Telomere Shortening, Cellular Senescence and Mitochondrial Dysfunction. International Journal of Molecular Sciences, 24(15): 12342.

[3] Shen L, Fan L, Luo H, et al., 2024, Cow Placenta Extract Ameliorates D-Galactose-Induced Liver Damage by Regulating Bax/Casp3 and p53/p21/p16 Pathways. Journal of Ethnopharmacology, 320: 117452.

[4] Zhang C, Meng Y, Han J, 2024, Emerging Roles of Mitochondrial Functions and Epigenetic Changes in the Modulation of Stem Cell Fate. Cellular and Molecular Life Sciences, 81(1): 26.

[5] Vaurs M, Dolu E, Decottignies A, 2023, Mitochondria and Telomeres: Hand in Hand. Biogerontology, 25(2): 289–300.

[6] Zheng Y, Wei Z, Wang T, et al., 2023, MOTS-c: A Promising Mitochondrial-Derived Peptide for Therapeutic Exploitation. Frontiers in Endocrinology, 14: 1123456.

[7] Zhao Y, Yang L, Que S, et al., 2024, Systemic Mechanism of Panax Notoginseng Saponins in Anti-Aging Based on Network Pharmacology Combined with Experimental Validation. Ibrain, 10(4): 519–535.

[8] Xing C, Zeng Z, Shan Y, et al., 2024, A Network Pharmacology-Based Study on the Anti-Aging Properties of Traditional Chinese Medicine Sisheng Bulao Elixir. Combinatorial Chemistry & High Throughput Screening, 27(12): 1840–1849.

[9] Wang J, Zhang J, Yu Z, et al., 2024, The Roles of Dietary Polyphenols in the Crosstalk Between Type 2 Diabetes and Alzheimer's Disease in Ameliorating Oxidative Stress and Mitochondrial Dysfunction Via the PI3K/Akt Signaling Pathway. Aging Research Reviews, 99: 102416.

[10] Pinzi L, Rastelli G, 2019, Molecular Docking: Shifting Paradigms in Drug Discovery. International Journal of Molecular Sciences, 20(18): 4331.

[11] Sara Pultsev A, Gusev E, Komelkova M, et al., 2023, JAK-STAT Signaling in Inflammation and Stress-Related Diseases: Implications for Therapeutic Interventions. Molecular Biomedicine, 4(1): 40.

[12] Childs B, Durik M, Baker D, et al., 2015, Cellular Senescence in Aging and Age-Related Diseases: From Mechanisms to Therapy. Nature Medicine, 21(12): 1424–1435.

[13] McIntyre R, Liu Y, Hu M, et al., 2022, Pharmaceutical and Nutraceutical Activation of FOXO3 for Healthy Longevity. Ageing Research Reviews, 78: 101621.

[14] Wan W, Zhang L, Lin Y, et al., 2023, Mitochondria-Derived Peptide MOTS-c: Effects and Mechanisms Related to Stress, Metabolism and Aging. Journal of Translational Medicine, 21: 36.

[15] Kong B, Lee C, Cho Y, 2023, Mitochondrial-Encoded Peptide MOTS-c, Diabetes, and Aging-Related Diseases. Diabetes & Metabolism Journal, 47(3): 315–324.

[16] Miller B, Keinan S, Ben-Meir D, et al., 2023, Mitochondrial-Derived Peptides in Cardiovascular Disease: Novel Insights and Therapeutic Opportunities. Trends in Cardiovascular Medicine, 33(8): 481–490.

[17] Zhang N, Baker E, Welsh T, et al., 2023, Telomere Dynamics in Livestock. Biology, 12(11): 1389.

[18] Jung E, Hong Y, 2023, Oral Intake of Porcine Placental Extract Improves Skin Hydration and Wrinkles in a Double-Blind Placebo-Controlled Clinical Study. Progress in Nutrition, 25(1): e2023007.

[19] Yang H, Zhang Q, Zhang B, et al., 2023, Potential Active Marine Peptides as Anti-Aging Drugs or Drug Candidates. Marine Drugs, 21(3): 144.

[20] Li M, Wang L, Zhang Q, et al., 2024, Exploring the Mechanism of Bazi Bushen Capsule in Delaying the

Senescence of Mesenchymal Stem Cells by Network Pharmacology Method. Chinese Journal of Experimental Traditional Medical Formulas, 30(8): 89–97.

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Investigation and Analysis of the Current Situation of Intrathecal Labor Analgesia and Childbirth in Jinan City

Xin Wang[1], Xiuqin Sun[2], Yan Zhao[1], Xinguo Liu[3]*

[1]Department of Anesthesiology, The Fifth People's Hospital of Jinan, Jinan 250022, Shandong, China
[2]Department of Obstetrics, The Fifth People's Hospital of Jinan, Jinan 250022, Shandong, China
[3]Jinan Third People's Hospital, Jinan 250101, Shandong, China

Author to whom correspondence should be addressed.

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Abstract: *Objective:* To understand the current status of intraspinal labor analgesia and childbirth in medical institutions in Jinan, and to promote the implementation of labor analgesia. *Methods:* The expert group of the Jinan Labor Analgesia Quality Control Center conducted quality inspections and childbirth surveys on labor analgesia in more than 20 hospitals across the city in 2019, 2021, and 2023. The inspections were conducted through hospital briefings, data reviews, and on-site visits, collecting data on the number of obstetric beds, monthly delivery volumes, natural birth rates, and rates of intraspinal anesthesia for labor analgesia in each hospital, and providing on-site feedback on inspection findings and recommendations for improvement. *Results:* Among the 24 public hospitals surveyed, there were 6 tertiary general hospitals, 15 secondary general hospitals, and 3 tertiary maternal and child health hospitals. Data collected from the survey: From January to July 2019, the total number of deliveries in the 24 hospitals was 36,101 cases, with an overall implementation rate of intraspinal labor analgesia of 16.5%, a pain relief rate of 51%, and maternal satisfaction of 50%. From January to August 2021, the total number of deliveries in the 24 public hospitals was 27,846 cases, with an overall rate of intraspinal labor analgesia of 34.0%, a pain relief rate of 82%, and maternal satisfaction of 79%. From January to October 2023, the total number of deliveries in 23 hospitals was 26,979 cases, with an overall rate of intraspinal labor analgesia of 55.9%, a pain relief rate of 100%, and maternal satisfaction of 98%. *Conclusion:* From 2019 to 2023, the rate of intraspinal labor analgesia in hospitals in Jinan significantly increased, and the effectiveness of labor analgesia significantly improved, but the total number of deliveries significantly decreased.

Keywords: Labor analgesia; Current situation of childbirth; Jinan city; Analgesic efficacy

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1. Introduction

In 2018, the National Health Commission launched a pilot program for labor analgesia [1,2] to promote and

standardize intraspinal labor analgesia. To implement national, provincial, and municipal guidelines and requirements regarding labor analgesia, and to comprehensively grasp the current status of childbirth and the implementation and quality of intraspinal labor analgesia in medical institutions across Jinan, the Jinan Labor Analgesia Quality Control Center conducted quality inspections and childbirth surveys on labor analgesia in more than 20 hospitals across the city. From 2019 to 2025, at meetings of the Jinan Labor Analgesia Quality Control Center, the Jinan Labor Analgesia Academic Annual Conference, and the Annual Conference of the Jinan Integrated Traditional Chinese and Western Medicine Midwifery Committee, relevant professional experts were invited to conduct training and lectures on issues related to labor analgesia. The expert group of the Labor Analgesia Quality Control Center conducted three research and supervision visits on intraspinal labor analgesia across the city in 2019, 2021, and 2023. The author of this article, as a member of the expert group, participated fully in the process, and all data were extracted by the author from the Labor Analgesia Quality Control Center. The findings from the three research and supervision visits are summarized as follows.

2. Materials and methods

2.1. Data sources

The first labor analgesia survey was conducted from July to August 2019, visiting a total of 24 public hospitals in Jinan City, districts, and counties that provide midwifery services, including 6 tertiary general hospitals, 15 secondary general hospitals, and 3 tertiary maternal and child health hospitals. The second labor analgesia supervision and inspection were conducted in September 2021, examining the same 24 public hospitals visited in 2019. The third labor analgesia quality control inspection was conducted from November to December 2023, investigating a total of 23 public hospitals in Jinan City, districts, and counties, as one public hospital had canceled its obstetrics department due to a very low number of deliveries. This study has been reviewed and approved by the Ethics Committee of Jinan Fifth People's Hospital, with the ethics review number 22-5-01.

2.2. Survey methods

The Jinan Labor Analgesia Professional Medical Quality Control Center organized centralized inspections by experts. The expert group consisted of specialists in anesthesiology, obstetrics, and midwifery. The inspections were conducted through hospital briefings, data reviews, and on-site visits, with on-site feedback provided on inspection findings and recommendations for improvement.

2.3. Inspection content

Data were collected on the number of obstetric beds, monthly delivery volumes, natural birth rates, rates of intraspinal anesthesia for labor analgesia, effectiveness of labor analgesia, and maternal satisfaction in each hospital. The effectiveness of labor analgesia, i.e., the pain relief rate during childbirth, refers to the proportion of parturients with a pain score of ≤ 3 one hour after analgesia implementation out of all sampled parturients. The use of facilities for intraspinal anesthesia for labor analgesia, including venues, equipment, consumables, and medications, was examined. The qualifications of personnel, work norms, charging practices, and relevant policy support for intraspinal labor analgesia in hospitals were inspected. The subjective and objective factors influencing the implementation of intraspinal labor analgesia were

summarized and analyzed.

3. Results

Data collected from the survey: From January to July 2019, the total number of deliveries in the 24 hospitals was 36,101 cases, with an average monthly delivery volume of 5,157 cases, a natural birth rate of 53.1%, and an overall implementation rate of intraspinal labor analgesia of 16.5% (see **Table 1**). Except for three pilot hospitals for labor analgesia, the labor analgesia rates in other medical institutions were all below 20%, with five hospitals having a "0" implementation rate. The pain relief rate was 51%, and maternal satisfaction was 50% (see **Table 2**). From January to August 2021, the total number of deliveries in the 24 public hospitals was 27,846 cases, with an average monthly delivery volume of 3,481 cases, a natural birth rate of 55.1%, and an overall rate of intraspinal labor analgesia of 34.0% (see **Table 1**). The pain relief rate was 82%, and maternal satisfaction was 79% (see **Table 2**). Eleven hospitals had an intraspinal labor analgesia rate of over 40%, with three hospitals exceeding 60%. From January to October 2023, the total number of deliveries in the 23 hospitals was 26,979 cases, with an average monthly delivery volume of 2,698 cases, a natural birth rate of 51.2%, and an overall rate of intraspinal labor analgesia of 55.9% (see **Table 1**). The pain relief rate was 100%, and maternal satisfaction was 98% (see **Table 2**). Eleven general hospitals had an intraspinal labor analgesia rate exceeding 55%, while the maternal and child health hospitals at the city and district levels had an intraspinal labor analgesia rate exceeding 85%. By analyzing the data obtained from the three surveys, we found that from 2019 to 2023, the number of deliveries in Jinan significantly decreased, the rate of intraspinal labor analgesia significantly increased, and the natural birth rate remained largely unchanged (see **Figure 1**). Both the pain relief rate and maternal satisfaction significantly increased.

Table 1. Labor analgesia and childbirth in Jinan

Year	Average monthly number of childbirths (cases)	Rate of natural childbirth (%)	Rate of labor analgesia (%)
2019	5157	53.1	16.5
2021	3481	55.1	34.0
2023	2698	51.2	55.9

Table 2. Efficacy of labor analgesia and maternal satisfaction in Jinan

Year	Parturients (n)	Analgesic effect/pain relief rate (%)	Maternal satisfaction rate (%)
2019	200	51	50
2021	200	82	79
2023	200	100	98

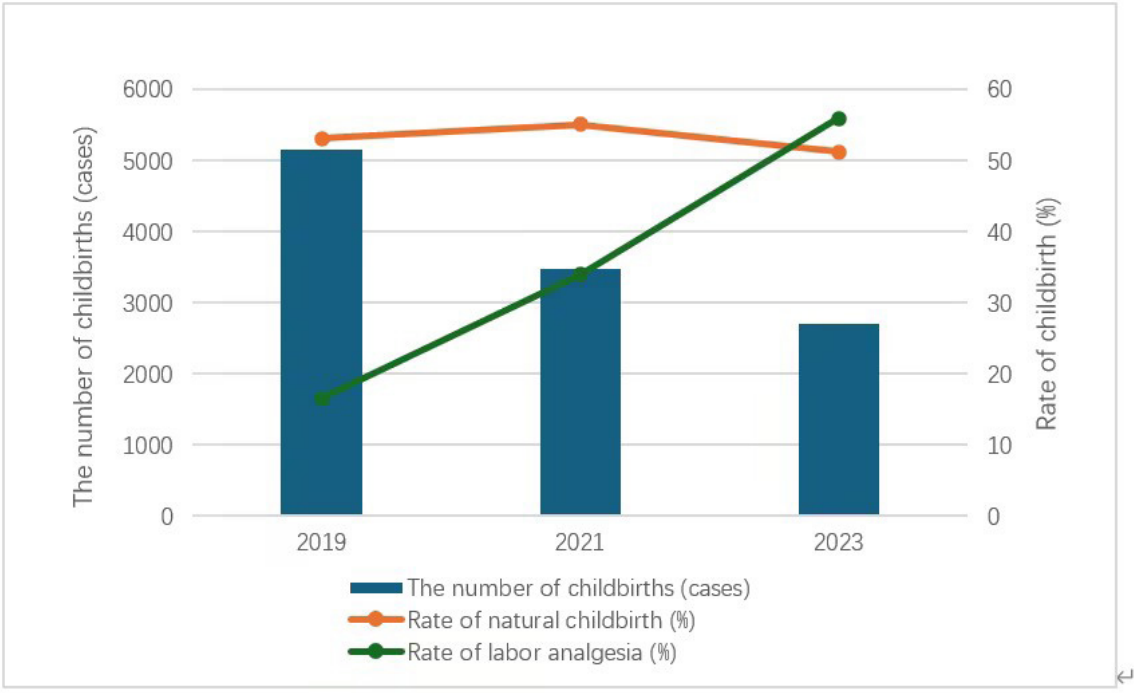


Figure 1. Labor analgesia and childbirth conditions in Jinan City.

4. Discussion

To alleviate labor pain in parturients and reduce the cesarean section rate, the "Happy Maternity Ward, Comfortable Childbirth" initiative launched by Professor Yao Shanglong and the "National Promotion Project for Comfortable Childbirth Analgesia" initiated by Professor Xu Mingjun in 2016, with support from the National Health Commission, promoted neuraxial labor analgesia across all provinces in China. This led to a significant increase in the rate of labor analgesia, greatly benefiting parturients. Since 2018, the National Health Commission has issued several documents [3, 4] encouraging the promotion of neuraxial labor analgesia, designating 912 hospitals as the first batch of pilot hospitals for labor analgesia. Through the leading role of these pilot hospitals and the regulatory role of local health commissions, the popularization and application of neuraxial labor analgesia techniques have been advanced. In 2021, the charge for labor analgesia in our city was filed with the medical insurance bureau as a self-paid item. The establishment of a separate charge item reflects the technical and labor value of medical personnel, enhancing their work enthusiasm. Given the shortage of anesthesiologists, hospitals have implemented incentive measures to encourage anesthesiologists to provide analgesia services through overtime work. With the joint efforts of the Jinan Health Commission, hospitals, and medical workers, the rate of labor analgesia has significantly increased, its implementation has become more standardized, facilities and equipment have become more comprehensive, and the analgesic effect has improved. Labor analgesia services have been fully rolled out in our city, with the labor analgesia rate exceeding the 40% quality control indicator set by the National Health Care Reform Center's goal of "increasing the application rate of neuraxial labor analgesia in patients undergoing vaginal delivery". Furthermore, the target of "achieving a 50% labor analgesia rate" proposed

by the Shandong Provincial Health Commission in the Notice on Further Enhancing Comprehensive Pain Service Capabilities on November 15, 2023, has been realized [5].

The increase in the rate of neuraxial labor analgesia can be attributed to several factors: the gradual maturation of neuraxial labor analgesia techniques, with a significant improvement in effectiveness, which not only alleviates labor pain in parturients but also promotes natural vaginal delivery, ensures maternal and infant safety, and accelerates postpartum recovery in parturients [6–8]. Increased publicity efforts, with hospitals conducting outreach activities in communities through events such as "Anesthesia Day", "International Midwives' Day", and "World Health Day", in addition to publicity efforts in maternity schools, enabling parturients to learn about, understand, and ultimately choose labor analgesia promptly; the growing recognition and trust in labor analgesia among parturients and their families, with the new concept of "happy childbirth" gradually replacing the old notion that "childbirth must be painful"; the inclusion of labor analgesia charges in medical insurance in some provinces and regions, alleviating the financial burden on parturients; increased attention from hospitals, with leaders recognizing the importance of labor analgesia through inspections and research by labor analgesia quality control centers, leading to improved staffing, material support, and policy backing for labor analgesia, as well as relevant incentive policies for anesthesiologists, obstetricians, and midwives in delivery rooms, and an increase in the number of anesthesiologists to support the implementation and development of neuraxial labor analgesia [9–11]. However, the clinical utilization rate of labor analgesia in China still lags behind that of Western countries, where the labor analgesia rate can reach 85% [12]. According to this survey, the labor analgesia rate in maternity hospitals in our city can reach 85%, but it is relatively low in general hospitals. Traditional beliefs among parturients and their families, a shortage of medical personnel, inaccurate timing of labor analgesia by midwives, and insufficient attention from hospitals to labor analgesia work are the main reasons for the current low rate of labor analgesia [13].

The survey results indicate a significant decline in the number of deliveries in Jinan hospitals from 2019 to 2023, which can be attributed to several factors: with social development and improved education levels, young people are delaying their age of first marriage and first childbirth, with late marriage and childbirth becoming increasingly common; modern individuals have higher aspirations for quality of life and place greater emphasis on personal development and enjoying life; the outbreak of the pandemic has postponed people's childbirth plans, leading to a decrease in the number of deliveries; the pandemic's impact on the global economy has affected employment and income for many, increasing life stress and reducing the desire for childbirth [14].

From 2023 to 2025, various provinces and cities have introduced corresponding childbirth incentive measures [15,16,17], and the state has issued the Implementation Plan for the Childcare Subsidy System. In 2023, the CPC Jinan Municipal Committee and the Jinan Municipal Government issued the Implementation Plan for Optimizing Childbirth Policies to Promote Long-term Balanced Population Development in Jinan, which stipulates that for families in the city's household registration system with second and third children born after January 1, 2023, in accordance with childbirth policies, a childcare subsidy of 600 yuan per child will be provided monthly until the child reaches the age of 3 [18]. In 2024, the Jinan Medical Security Bureau issued the Regulations on Maternity Insurance Benefits for Employees, providing maternity allowances to in-service employees. On January 18, 2025, the 13th Session of the Standing Committee of the 14th Shandong Provincial People's Congress reviewed and approved the Decision of the Standing Committee of the Shandong Provincial People's Congress on Amending the Regulations on Population and Family

Planning in Shandong Province, extending marriage leave to a maximum of 18 days, implementing tax preferential policies such as special additional deductions for individual income tax for infant care and children's education, and including appropriate labor analgesia and assisted reproductive technology items in the scope of medical insurance reimbursement. Population issues are closely linked to national development. To encourage childbearing women to have children actively, better collaboration is needed among the government, enterprises, institutions, and communities to introduce more detailed measures to alleviate families' concerns, such as government policies providing rewards or tax exemptions to units for hiring female workers, encouraging units to employ female workers, establishing unit or community childcare services, extending maternity leave, providing parental leave for both parents, and advocating through public opinion the benefits of childbearing at an appropriate age for women's physical and mental health, guiding families to eliminate childbirth anxiety, and effectively enhancing women's willingness to have children, thereby alleviating families' concerns.

As an important component of comfortable medical care, neuraxial labor analgesia significantly alleviates labor pain in parturients, promotes natural childbirth, and ensures maternal and infant safety and health. Due to its proven effectiveness, its utilization rate is increasing, while the use of other methods of labor analgesia is decreasing [19]. There is still room for improvement in the development of labor analgesia. A small number of parturients have contraindications to neuraxial anesthesia or harbor concerns about invasive procedures, making them unable or unwilling to undergo neuraxial labor analgesia. Research by Wang Jianpeng et al. indicates that acupuncture anesthesia for labor analgesia is effective, with few complications and high safety. For parturients with contraindications to neuraxial anesthesia or those unwilling to undergo invasive procedures, acupuncture anesthesia or intravenous anesthesia, as well as other non-pharmacological labor analgesia methods, such as psychological support techniques, free positioning, the Lamaze breathing method, doula instruments, massage, music therapy, aquapuncture analgesia, and laboring in water, can be considered [20,21].

5. Conclusion

In summary, from 2019 to 2023, the rate of neuraxial labor analgesia in Jinan hospitals has significantly increased, and the effectiveness of labor analgesia has markedly improved, although the total number of deliveries has significantly declined. This survey investigated the current status of childbirth and the implementation of neuraxial labor analgesia in medical institutions across Jinan, further standardizing the treatment process and charges for labor analgesia and enhancing the safety and quality of labor analgesia medical care. We hope that with the efforts of the government, hospitals, and society as a whole, the quality of labor analgesia will continue to improve, its utilization rate will keep increasing, and more parturients will truly benefit, enjoying "happy childbirth".

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Notice on Strengthening and Improving Anesthesia Medical Services (National Health Commission Document No. [2018]21) [EB/OL]. 2018-08-08.

[2] Notice on Carrying out the Pilot Program for Labor Analgesia (National Health Commission Office Document No. [2018]1009) [EB/OL]. 2018-11-15.

[3] Notice of the General Office of the National Health Commission on Issuing the First Batch of National Pilot Hospitals for Labor Analgesia (National Health Commission Office Document No. [2019]284) [EB/OL]. 2019-03-18.

[4] Notice of the General Office of the National Health Commission on Issuing the Guidelines for Capacity Building of Anesthesia Department Medical Services (Trial) (National Health Commission Office Document No. [2019]884) [EB/OL]. 2019-12-09.

[5] Notice of the Shandong Provincial Health Commission on Issuing the Shandong Province Action Plan for Improving Medical Experience and Enhancing Patient Satisfaction (2023–2025) (Shandong Health Commission Document No. [2023]283) [EB/OL]. 2023-12-27.

[6] Shen X, Li Y, Xu S, et al., 2017, Epidural Analgesia During the Second Stage of Labor: A Randomized Controlled Trial. Obstet Gynecol, 130(5): 1097–1130.

[7] Sun J, Yan X, Yuan A, et al., 2019, Effect of Epidural Analgesia in Trial of Labor After Cesarean on Maternal and Neonatal Outcomes in China: A Multicenter, Prospective Cohort Study. BMC Pregnancy Childbirth, 19(1): 498.

[8] Liu L, Xuan R, Zhu H, et al., 2019, Analysis of the Effect of Epidural Labor Analgesia on Inflammatory Factors, Complement, and Immune Function in Parturients. Chinese Journal of General Practice, 2(2): 241–244.

[9] Notice on Matters Concerning the Inclusion of Some New Medical Service Items into the Basic Medical Insurance Payment Scope of this Municipality (Shanghai Medical Insurance Bureau Document No. [2022]6) [EB/OL]. 2021-04-06.

[10] Notice of Jiangsu Provincial Medical Security Bureau on Including Neuraxial Labor Analgesia into the Basic Medical Insurance Payment Scope (Jiangsu Medical Insurance Bureau Document No. [2024]36) [EB/OL]. 2024-06-24.

[11] Notice on Adjusting and Improving the Pricing Items and Medical Insurance Payment Policies for Neuraxial Anesthesia and Other Medical Services (Zhejiang Medical Insurance Bureau Document No. [2022]40) [EB/OL]. 2022-11-17.

[12] Xu M, Yao S, 2016, Analysis of the Current Status and Implementation Strategies of Labor Analgesia in China. Chinese Journal of Medical Guide, 51(08): 4–7 + 2.

[13] Sun X, Liu X, Zhong W, 2021, Investigation on the Current Status and Development Strategies of Labor Analgesia in 24 Hospitals in Jinan. China Medicine and Pharmacy, 11(18): 171–174.

[14] Shen X, 2024, A Study on the Fertility Intentions of Women in Shandong Province Under the COVID-19 Pandemic, thesis, Shandong University.

[15] Notice of the General Office of the Provincial Government on Issuing Several Measures of Jiangsu Province to Accelerate the Improvement of the Fertility Support Policy System and Promote the Construction of a Fertility-Friendly Society (Jiangsu Provincial Government Office Document No. [2025]2) [EB/OL]. 2025-01-11.

[16] Notice on the Implementation Measures for Childcare Subsidies in Hangzhou (Trial) (Hangzhou Health Commission Document No. [2023]38) [EB/OL]. 2023-08-07.

[17] Notice of Zhengzhou Municipal People's Government on Issuing the Implementation Measures for Optimizing Fertility Policies and Promoting Long-Term Balanced Population Development (Zhengzhou Government Document No. [2023]19) [EB/OL]. 2023-08-21.

[18] Implementation Plan for Optimizing Fertility Policies and Promoting Long-Term Balanced Population Development in Jinan [EB/OL]. 2023-01-11.

[19] Wang Y, Du H, Zeng H, et al., 2024, A Survey on the Current Status of Neuraxial Labor Analgesia in Maternity Hospitals in Beijing. International Journal of Anesthesiology and Resuscitation, 45(06): 579–585.

[20] Wang X, Sun Z, Jin X, et al., 2024, Analysis of the Analgesic Effect of Simple Microneedle Therapy for Labor Analgesia. Modern Chinese Clinical Medicine, 31(04): 34–38.

[21] Wang Y, Luo B, Xu X, et al., 2020, A Survey Study on the Current Status of Labor Analgesia in Medical Institutions in China. Journal of Nursing Science, 35(12): 16–19+41.

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The Impact of Guidance on Limb Function Exercises on the Recovery of Motor Function in Patients with Cerebral Infarction

Yan Zhu

Taizhou Second People's Hospital, Taizhou 225500, Jiangsu, China

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Abstract: *Objective:* To investigate the clinical value of guidance on limb function exercises in the rehabilitation of patients with cerebral infarction, providing objective data support for optimizing rehabilitation plans during the recovery period and enhancing overall rehabilitation outcomes. *Methods:* This study selected 114 patients with cerebral infarction admitted to our hospital from June 2024 to January 2026. They were randomly divided into a control group and an observation group, with 57 patients in each group. The control group received basic rehabilitation training, while the observation group received specialized guidance on limb function exercises in addition to basic rehabilitation training. Motor function, self-care ability, neurological function, and activities of daily living were compared between the two groups. *Results:* Compared to before the intervention, scores for motor function, self-care ability, and activities of daily living increased in both groups after the intervention, with higher scores in the observation group. Neurological function scores decreased in both groups, with lower scores in the observation group (all $p < 0.05$). *Conclusion:* Combining systematic guidance on limb function exercises with basic rehabilitation training can effectively improve motor and neurological functions, as well as enhance self-care ability and activities of daily living in patients with cerebral infarction.

Keywords: Cerebral infarction; Limb function; Exercise; Guidance; Motor function

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1. Introduction

Cerebral infarction is a clinically prevalent acute cerebrovascular disease characterized by sudden onset, high disability rates, and a long recovery period. Ischemia and hypoxia in brain tissue cause damage to nerve cells, leading to varying degrees of sequelae such as limb hemiplegia, motor dysfunction, and neurological deficits in most patients after onset. These sequelae directly result in restricted limb movement and decreased self-care ability, severely affecting patients' quality of daily life and imposing a heavy caregiving and economic burden on families and society. Rehabilitation interventions are crucial for improving prognosis and reducing disability during the recovery period of cerebral infarction. Currently, conventional basic rehabilitation

training is commonly used for patients with cerebral infarction in clinical settings; however, the training content is relatively general, and the process is rigid, often focusing on passive activities and lacking individualized, phased professional guidance for limb function exercises [1]. Guidance on limb function exercises relies on rehabilitation assessment results to develop stratified and systematic exercise plans for patients, while simultaneously conducting action demonstrations, home training education, and dynamic adjustments to training plans, thereby compensating for the deficiencies of basic rehabilitation [2]. At present, systematic comparative studies on the comprehensive rehabilitation effects of standardized guidance on limb function exercises in patients with cerebral infarction remain limited. Based on this, this grouped comparative study was conducted.

2. Materials and methods

2.1. General information

This study selected 114 patients with cerebral infarction admitted to the neurology department of our hospital from June 2024 to January 2026 as the research subjects. They were divided into two groups using a random number table method.

(1) Control group

31 males and 26 females; aged 45–78 (61.25 ± 5.14) years; disease duration 7–28 (16.52 ± 3.18) days; hemiplegia types: 52 cases of unilateral hemiplegia and 5 cases of bilateral hemiplegia.

(2) Observation group

30 males and 27 females; aged 44–79 (60.98 ± 5.21) years; disease duration 8-27 (16.57 ± 3.15) days; hemiplegia types: 50 cases of unilateral hemiplegia and 7 cases of bilateral hemiplegia.

Comparison of the aforementioned baseline data between the two groups showed $p > 0.05$, indicating comparability. This study was approved by the Medical Ethics Committee of our hospital.

2.2. Diagnostic criteria

This study referred to the diagnostic criteria for cerebral infarction in the "Chinese Consensus on the Diagnosis and Treatment of Hemorrhagic Transformation after Acute Cerebral Infarction 2019" [3].

2.3. Inclusion criteria

Patients who met the clinical diagnostic and imaging confirmation criteria for cerebral infarction and were in a stable rehabilitation phase of their condition; those with sequelae such as limb hemiplegia and restricted motor function; those who were conscious with normal cognitive, comprehension, and communication abilities, enabling them to cooperate in completing rehabilitation training and scale assessments; those with stable vital signs and no severe acute complications; those with complete clinical data who voluntarily participated in this study and signed informed consent forms, and were able to cooperate in completing the entire intervention.

2.4. Exclusion criteria

Patients with diseases affecting limb movement, such as cerebral hemorrhage, brain tumors, Parkinson's disease, and severe bone and joint diseases; those with failure of vital organs such as the heart, liver, and kidneys, malignant tumors, severe mental illnesses, and cognitive impairments; those with pre-existing limb disabilities or motor dysfunctions before onset.

2.5. Withdrawal and exclusion criteria

Patients who actively withdrew, gave up rehabilitation interventions, or transferred to another hospital during the study period, making it impossible to complete the entire observation; those whose condition suddenly worsened, experienced new cerebrovascular accidents, or developed severe complications during the study, interfering with the determination of various indicators.

2.6. Methods

2.6.1. Control group (basic rehabilitation training)

(1) Basic positional care

Assist patients in maintaining proper limb positions and regularly assist in turning every 2 hours to prevent pressure sores and limb joint contractures.

(2) Passive limb training

Conduct basic limb activities twice daily for 30 minutes each time. Nursing staff assist patients in performing simple flexion, extension, and rotation movements of major joints such as the shoulders, elbows, wrists, hips, knees, and ankles, as well as regular muscle massages for hemiplegic limbs.

(3 Simple active training

Verbally encourage patients to independently perform simple movements such as raising their hands and legs and grasping objects.

(4) Basic activities of daily living training

Briefly instruct patients on performing daily actions such as dressing, eating, and washing, providing procedural prompts.

(5) Rehabilitation education

Provide a verbal explanation of rehabilitation precautions upon admission.

2.6.2. The observation group (limb function exercises in addition to basic rehabilitation training)

(1) Phased guidance on limb function exercises

① Bedridden phase: Demonstrate one-on-one passive movement techniques for all body joints, moving major joints in order from proximal to distal ends, controlling the angle and intensity of movements to avoid traction injuries; instruct family members to assist in completing training and correct incorrect techniques on-site. Demonstrate massage techniques for hemiplegic limbs, focusing on massaging the upper arm, thigh, and calf muscle groups, explaining massage frequency and intensity requirements to promote local blood circulation and prevent muscle atrophy. Guide patients in using their unaffected limbs to drive their affected limbs to complete lifting, translation, flexion, and extension movements, providing hands-on guidance on force application; practice basic hand movements such as clenching fists and extending fingers in bed to exercise hand muscle strength. Standardize demonstrations of three standard proper limb positions: supine, affected-side lying, and unaffected-side lying, explaining the key points and effects of different positions, and regularly check and correct improper positions. ② Bed-exit transition phase: Gradually guide patients from lying flat to semi-sitting and then to sitting up completely, practicing unsupported sitting balance at the bedside; demonstrate body weight shift movements, correcting issues such as body leaning and weight shift, and gradually extend sitting time. Assist patients in standing with the support of beds or walkers, demonstrating proper standing posture, guiding patients to distribute their weight on both feet evenly, and

practicing marching in place to improve standing stability gradually. Increase training for lifting, abducting, and adducting the affected limbs to strengthen muscle strength; continue to consolidate joint movement training, appropriately increasing the range of motion. Guide patients in practicing front-to-back and left-to-right weight shift exercises to lay the foundation for walking training. ③ Functional enhancement phase: Demonstrate proper walking posture, stride length, and speed, initially assisting with walking and then transitioning to independent walking; provide real-time corrections for patients with abnormal gaits and gradually practice turning and short-distance walking. Increase lifting and stretching training for the upper limbs; practice knee flexion, hip extension, and stair climbing for the lower limbs, following a gradual and progressive principle to gradually increase training intensity. Conduct training such as threading beads, buttoning buttons, holding chopsticks, and grasping small objects, providing one-on-one guidance on action details to improve hand dexterity. Combine limb exercises with daily actions, providing specialized guidance on actions such as dressing, using the toilet, washing, and climbing stairs, breaking down steps and practicing repeatedly to improve self-care ability.

(2) Supporting management measures

Accompany patients throughout each training session, promptly correcting non-standard movements; dynamically adjust training duration and intensity based on patients' fatigue levels and limb tolerance. Both groups received continuous interventions for 4 weeks.

2.7. Observation indicators

(1) Limb motor function

Before and after the intervention, the Fugl-Meyer Motor Function Assessment Scale (FMA) was used for evaluation. This scale has a total score of 100 points and includes two major dimensions: upper limbs (66 points) and lower limbs (34 points).

(2) Self-care ability

Before and after the intervention, the Exercise of Self-Care Agency Scale (ESCA) was used for evaluation. The scale consists of 43 items and includes four dimensions: self-concept (32 points), self-care responsibility (24 points), self-care skills (48 points), and health knowledge level (68 points), with a total score of 172 points. A higher score indicates stronger self-care ability in patients.

(3) Neurological function and activities of daily living

Before and after the intervention, the National Institutes of Health Stroke Scale (NIHSS) was used to assess the degree of neurological deficits in patients, with a total score of 42 points. A higher score indicates more severe neurological deficits. The Barthel Index (BI) was used to assess patients' activities of daily living, with a total score of 100 points. A higher score indicates stronger independent living ability in patients.

2.8. Statistical analysis

The data from this study were analyzed using SPSS 26.0 statistical software. Measurement data conforming to a normal distribution were expressed as ($\overline{x} \pm s$), and differences between groups were compared using the *t*-test. Count data were expressed as frequencies and percentages (%), and differences between groups were compared using the χ^2 test. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Limb motor function

Compared to before the intervention, limb motor function scores increased in both groups after the intervention, with higher scores in the observation group ($p < 0.05$). See **Table 1**.

Table 1. Limb motor function [$\overline{x} \pm s$, points]

Group	Number of cases	Upper limb function		Lower limb function	
		Before intervention	After intervention	Before intervention	After intervention
Control group	57	38.12 ± 5.06	45.79 ± 4.32	19.41 ± 3.24	24.25 ± 2.86
Observation group	57	37.98 ± 5.16	51.13 ± 3.16	19.27 ± 3.35	26.24 ± 2.53
t value	-	0.146	7.532	0.227	3.935
p value	-	0.884	< 0.001	0.821	< 0.001

3.2. Self-care ability

Compared to before the intervention, the self-care ability scores of both groups increased after the intervention, with the observation group showing a higher score, $p < 0.05$. See **Table 2**.

Table 2. Self-Care Ability [$\overline{x} \pm s$, score]

Group	Number of cases	Self-concept		Self-care responsibility		Self-care skills		Health knowledge level	
		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Observation group	57	18.37 ± 2.75	21.56 ± 2.63	14.22 ± 2.14	16.86 ± 2.07	20.21 ± 3.25	26.92 ± 3.14	29.36 ± 4.04	36.75 ± 3.94
Control group	57	18.32 ± 2.69	25.19 ± 2.43	14.18 ± 2.09	19.87 ± 1.92	21.03 ± 3.43	39.53 ± 2.79	29.25 ± 3.98	48.27 ± 3.65
t value		0.098	7.654	0.101	8.049	1.310	22.705	0.146	16.194
p value		0.922	< 0.001	0.920	< 0.001	0.193	< 0.001	0.884	< 0.001

3.3. Neurological function and daily living abilities

Compared to before the intervention, both groups showed a decrease in neurological function scores after the intervention, with the observation group having a lower score. Both groups also exhibited an increase in daily living ability scores, with the observation group scoring higher ($p < 0.05$). See **Table 3**.

Table 3. Neurological function and daily living abilities [$\overline{x} \pm s$, points]

Group	Number of cases	NIHSS score		BI index	
		Before intervention	After intervention	Before intervention	After intervention
Control group	57	17.85 ± 3.12	11.24 ± 2.89	46.33 ± 6.72	65.27 ± 6.23
Observation group	57	18.04 ± 3.17	6.51 ± 2.32	45.98 ± 6.63	83.11 ± 4.02
t value	-	0.323	9.636	0.280	18.166
p value	-	0.748	< 0.001	0.780	< 0.001

4. Discussion

After the onset of cerebral infarction, ischemic damage occurs in the brain tissue, which is prone to causing neurological deficits and leaving sequelae such as limb hemiplegia and motor dysfunction. This not only restricts patients' limb movements but also weakens their self-care abilities, seriously affecting their quality of daily life. Conventional basic rehabilitation training typically involves simple limb activities, postural care, and verbal instructions, with a monotonous and unsystematic training format. It fails to develop personalized plans based on patients' muscle strength and recovery status, lacks professional movement demonstrations and error corrections, and struggles to fully activate the repair potential of nerves and limbs, resulting in limited overall rehabilitation effects [4].

The results of this study showed that after the intervention, the Fugl-Meyer Assessment (FMA) scores for both the upper and lower limbs in both groups improved compared to before the intervention, with the observation group scoring higher than the control group ($p < 0.05$). The reasons for this are as follows: simple basic rehabilitation training primarily focuses on passive activities with general training content, making it easy for patients to exhibit problems such as non-standard movements and incorrect force application, which are ineffective in exercising limb muscle strength and coordination. In contrast, limb function exercise guidance is divided into three stages, bedridden period, bed-leaving transition period, and functional enhancement period—based on patients' recovery conditions, following a step-by-step rehabilitation principle. It involves one-on-one demonstrations of standard movements, timely correction of incorrect postures, and incorporates diverse content such as joint activities, muscle strength training, and gait exercises. This approach continuously stimulates damaged neural pathways, promotes neural function remodeling, gradually improves limb muscle strength, joint range of motion, and motor coordination, and thereby enhances limb motor ability [5].

The results of this study also indicated that after the intervention, the scores in each dimension and the total score of the Exercise of Self-Care Agency (ESCA) scale were higher in both groups compared to before the intervention, with the observation group showing a more pronounced improvement ($p < 0.05$). The reasons for this are as follows: basic rehabilitation only provides one-time verbal education upon admission, leaving patients with insufficient knowledge of rehabilitation and self-care skills. In contrast, the observation group concurrently conducted regular rehabilitation education, explaining disease knowledge, exercise essentials, and home rehabilitation methods during the training process, while integrating limb training with daily activities such as dressing and washing, breaking down movement steps and practicing repeatedly [6]. As patients master rehabilitation skills, they gradually learn to independently complete daily tasks, leading to a significant improvement in their self-care abilities.

Furthermore, the results of this study showed that after the intervention, the National Institutes of Health Stroke Scale (NIHSS) scores decreased and the Barthel Index (BI) scores increased in both groups, with the observation group demonstrating greater improvements in these indicators compared to the control group ($p < 0.05$). The reasons for this are as follows: limb function exercise guidance, through scientific and regular limb activities, can improve systemic blood circulation, provide favorable repair conditions for damaged brain tissue, facilitate neural function recovery, and reduce the degree of neurological deficits [7]. Meanwhile, the simultaneous improvement in limb motor function and self-care abilities enables patients to gradually independently perform daily activities such as eating, walking, and toileting, significantly reducing their reliance on others for care and thereby enhancing their daily living abilities.

5. Conclusion

In summary, combining systematic limb function exercise guidance with basic rehabilitation training for patients with cerebral infarction can effectively improve their limb motor and neurological functions, enhance their self-care abilities, and improve their daily living abilities.

Disclosure statement

The author declares no conflict of interest.

References

[1] Lai H, Guo J, Zhang P, 2025, Analysis of the Impact of Early Rehabilitation Nursing on Exercise Compliance and Limb Motor Function in Patients with Hemiplegia After Cerebral Infarction. Clinical Research, 33(3): 157–160.

[2] Chen Y, Xu Q, 2025, Research on Limb Function Exercise Combined with Time Nursing in Patients with Cerebral Infarction. Primary Medical Forum, 29(5): 102–105.

[3] Neurology Branch of the Chinese Medical Association, Cerebrovascular Disease Group of the Neurology Branch of the Chinese Medical Association, 2019, Chinese Consensus on the Diagnosis and Treatment of Hemorrhagic Transformation After Acute Cerebral Infarction 2019. Chinese Journal of Neurology, 52(4): 252–265.

[4] Ma Y, 2025, The Impact of Limb Function Exercise Combined with Health Education on Limb Motor Function and Quality of Life in Patients with Acute Cerebral Infarction. Journal of Shandong Medical College, 47(2): 98–100.

[5] Nie D, 2025, The Impact of Collaborative Hand Function Exercise on Rehabilitation Outcomes in Patients with Cerebral Infarction. China Modern Doctor, 63(1): 26–29.

[6] Huang C, 2025, Research on Limb Function Exercise Combined with Time Nursing in Patients with Cerebral Infarction. Chinese Science and Technology Journal Database (Citation Edition) Medicine and Hygiene, (7): 110–114.

[7] Fei C, Xie J, Gu Y, et al., 2022, Research on the Application Effect of Diversified Hand Function Exercises in Patients with Hand Dysfunction After Cerebral Infarction. Journal of Chongqing Medical University, 47(7): 828–833.

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Observation on the Effect of Specialized Respiratory Tract Care in Preventing Pulmonary Infection after Cardiothoracic Surgery

Qing Huang

Taizhou Second People's Hospital, Taizhou 225500, Jiangsu, China

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Abstract: *Objective:* To compare the application effects of routine care and routine care combined with specialized respiratory tract care in patients after cardiothoracic surgery. *Methods:* This study involved 102 patients who underwent cardiothoracic surgery in our hospital from September 2024 to December 2025. They were randomly divided into a control group (51 cases) and an observation group (51 cases). The control group received routine postoperative care for cardiothoracic surgery, while the observation group received specialized respiratory tract care in addition to routine care. The postoperative recovery, effective expectoration rate, and incidence of postoperative pulmonary complications were compared between the two groups. *Results:* The observation group had shorter ICU stays, drainage tube indwelling times, and hospital stays than the control group, with $p < 0.05$. The effective expectoration rate in the observation group was higher than that in the control group, with $p < 0.05$. The total incidence of postoperative pulmonary complications in the observation group was lower than that in the control group, with $p < 0.05$. *Conclusion:* Adding specialized respiratory tract care to routine postoperative care in cardiothoracic surgery can effectively improve the effective expectoration rate, reduce the incidence of pulmonary complications, and promote postoperative recovery in patients.

Keywords: Cardiothoracic surgery; Postoperative; Pulmonary infection; Respiratory tract; Specialized care

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1. Introduction

Cardiothoracic surgery is a core method for treating organic lesions of the heart and thoracic organs. The large surgical trauma, tracheal intubation during surgery, and manipulation of thoracic organs can significantly interfere with the patient's respiratory function. Additionally, factors such as postoperative incision pain, bed rest, and decreased respiratory muscle strength can easily lead to sputum accumulation, inadequate pulmonary ventilation, atelectasis, and other issues, thereby inducing pulmonary infection [1]. Pulmonary infection is one of the most common and high-incidence complications after cardiothoracic surgery. It not only prolongs the patient's recovery period, increases the risk of secondary complications

such as pleural effusion and respiratory failure, but also increases the patient's physical suffering and economic burden. In severe cases, it can endanger the patient's life safety and is a key risk factor affecting the prognosis of cardiothoracic surgery. Currently, routine care models are commonly used for patients after cardiothoracic surgery in clinical settings, but these care measures are relatively general and lack specificity [2]. With the continuous updating of modern surgical care concepts, refined and specialized care has become the mainstream trend for preventing postoperative complications. Specialized respiratory tract care focuses on the postoperative respiratory function characteristics and high-risk factors for infection in cardiothoracic patients, formulating targeted and systematic intervention measures that can precisely compensate for the shortcomings of routine care. However, the standardized application effects of this care model in preventing pulmonary infections after cardiothoracic surgery and its impact on the overall postoperative recovery of patients still require further systematic verification. Based on this, this controlled study was conducted.

2. Materials and methods

2.1. General information

This study selected 102 patients who underwent surgical treatment in the cardiothoracic surgery department of our hospital from September 2024 to December 2025 as the research subjects. They were randomly divided into two groups using a random number table method. The above general baseline data were comparable between the two groups, with $p > 0.05$. This study was approved by the Medical Ethics Committee of our hospital.

2.1.1. Control group

28 males and 23 females; aged 32–75 (53.68 ± 6.42) years; surgical types: 22 cardiac surgeries, 16 pulmonary lobectomies, 8 esophageal surgeries, and 5 mediastinal surgeries.

2.1.2. Observation group

29 males and 22 females; aged 30–74 (52.95 ± 6.81) years; surgical types: 21 cardiac surgeries, 17 pulmonary lobectomies, 9 esophageal surgeries, and 4 mediastinal surgeries.

2.2. Diagnostic criteria

This study referred to the diagnostic criteria for postoperative pulmonary infection in the "Chinese Adult Hospital-Acquired Pneumonia and Ventilator-Associated Pneumonia Diagnosis and Treatment Guidelines (2018 Edition)" [3].

2.3. Inclusion criteria

Patients who met the indications for cardiothoracic surgery, underwent their first routine surgical treatment for the heart, lungs, esophagus, mediastinum, or other cardiothoracic conditions, had a smooth surgical process, and were successfully transferred to the ICU or general ward for subsequent treatment and care after surgery; were conscious and able to cooperate with postoperative care, expectoration, and rehabilitation interventions; had complete clinical data, voluntarily participated in this study, signed an informed consent form, and were able to cooperate with the entire study process.

2.4. Exclusion criteria

Patients with pre-existing active pulmonary infections, severe emphysema, respiratory failure, severe asthma, or other serious respiratory diseases before surgery; those with severe liver and kidney failure, coagulation disorders, advanced malignant tumors, or severe autoimmune diseases; long-term smokers who did not quit smoking before surgery; long-term users of immunosuppressants; and patients with severely compromised immunity.

2.5. Dropout and exclusion criteria

Patients who actively requested to withdraw from the study, gave up treatment, or transferred to another hospital during the study process and were unable to complete the entire observation period; those who did not strictly adhere to the research care plan, privately changed the care method, or interrupted the intervention, affecting the accuracy of experimental data; those who developed other nosocomial infections or complications during the study period that interfered with the judgment of pulmonary infection observation indicators.

2.6. Methods

The control group received routine postoperative care:

(1) Basic condition monitoring

After surgery, closely monitor vital signs such as body temperature, heart rate, blood pressure, blood oxygen saturation, and respiratory rate. Observe for any bleeding or exudation at the incision site, properly secure various drainage tubes, maintain tube patency, and record the color, volume, and characteristics of the drainage fluid. After the patient is transferred to the ICU and general ward, complete the handover of the patient's condition according to the department's routine procedures.

(2) Basic respiratory tract care

Conduct routine nebulization inhalation twice daily as prescribed by the doctor after surgery. When the patient expresses a desire to expectorate, encourage them to cough and expectorate on their own. If the sputum is thick and difficult to expectorate independently, perform simple suctioning. Regularly auscultate the lung's breath sounds and promptly inform the doctor of any abnormalities for handling.

(3) Posture and activity care

Provide routine bed rest posture care after surgery. Once vital signs are stable, guide the patient to change their posture independently.

(4) Basic health education and dietary care

Briefly explain postoperative precautions and dietary restrictions, instruct the patient to consume high-protein, light, and easily digestible foods, and verbally remind them to drink small amounts of water.

(5) Ward management

Routinely open windows for ventilation and clean and disinfect the floor daily, adhering to the basic hospital infection management requirements of the ward.

The observation group fully adopted the routine care content of the control group while adding specialized respiratory tract care:

(1) Respiratory tract health education and psychological intervention

Immediately after surgery, provide one-on-one explanations of the hazards of postoperative pulmonary

infection and sputum retention, demonstrate correct coughing and breathing techniques, and alleviate the patient's fear and resistance to expectorating due to incision pain. Share rehabilitation cases to enhance cooperation. Instruct the patient and their family to drink sufficient water after surgery, with a daily intake controlled between 1500 and 2000 mL to dilute the sputum.

(2) Multimodal analgesia and effective cough guidance

Implement multimodal analgesia by combining a patient-controlled analgesia pump with analgesic drugs to minimize chest wall incision pain and eliminate the patient's fear of coughing due to pain. Guide patients on effective expectoration techniques based on their type: for explosive coughing, take a deep breath, hold it, contract the abdomen, and then suddenly open the glottis to cough forcefully; for segmented coughing, cough softly and continuously in segments, suitable for patients with poor tolerance to incision pain. Regularly supervise and practice these techniques 3-4 times daily.

(3) Standardized airway humidification and nebulization intervention

In addition to routine nebulization, use continuous oxygen heating and humidification to maintain respiratory tract mucosa moisture and prevent airway dryness and sputum crusting. Adjust nebulization drugs and frequency based on sputum viscosity. Increase nebulization frequency for patients with grade III sputum viscosity to enhance sputum dilution.

(4) Postural drainage and mechanical/manual percussion for sputum expectoration

Assist the patient in assuming a semi-reclining or lateral position based on the surgical site and lung lesion location to promote bronchial sputum drainage by gravity. Perform this twice daily for 15–20 minutes each time, avoiding the hour after meals. The nursing staff should cup their hands and percuss the patient's chest and back evenly from bottom to top and from outside to inside, with a force appropriate to the patient's tolerance, avoiding the surgical incision, heart, and breast areas. Perform this after nebulization, 10–15 minutes each time, to loosen deep airway sputum.

(5) Systematic respiratory function training

Initiate training immediately after the patient regains consciousness and vital signs stabilize, twice daily for 15–20 minutes each time: ① Diaphragmatic breathing: Place hands on the upper abdomen, inhale to expand the abdomen, and exhale to contract it, breathing slowly and evenly. ② Pursed-lip breathing: Inhale through the nose and exhale slowly through pursed lips to prolong exhalation time and improve lung ventilation. ③ Depending on the patient's recovery, add balloon blowing exercises to promote lung re-expansion. Both groups received continuous care until the day before discharge.

2.7. Observation indicators

(1) Postoperative recovery

Record the ICU stay duration, drainage tube indwelling time, and hospital stay duration for both groups.

(2) Effective expectoration rate

Effective expectoration is defined as the patient's ability to smoothly expectorate airway sputum through independent coughing or simple assisted percussion, resulting in clear airways and a significant reduction or disappearance of lung auscultation rales without the need for negative pressure suction intervention. Ineffective expectoration is defined as difficulty in independent coughing, persistent or increased lung wet rales, and the necessity of negative pressure suction to clear sputum.

(3) Incidence of postoperative pulmonary complications, including pulmonary infection and atelectasis.

2.8. Diagnostic criteria for postoperative pulmonary infection

(1) Fever ≥ 38.0°C in the axillary temperature 48 hours or more after surgery, excluding infections at other sites such as incision or urinary tract infections;
(2) Presence of persistent respiratory symptoms such as cough, expectoration, chest tightness, shortness of breath, or dyspnea;
(3) Auscultation of localized or diffuse wet rales or decreased breath sounds in the lungs;
(4) Blood tests indicating a significant increase in white blood cell count and neutrophil percentage;
(5) Chest X-ray/CT showing new inflammatory infiltrates or patchy shadows in the lungs. A diagnosis can be confirmed if ≥3 of the above criteria is met.

2.9. Statistical analysis

The study data were analyzed using SPSS 26.0 statistical software. Normally distributed measurement data are presented as ($\overline{x} \pm s$), and intergroup differences were compared using the *t*-test. Count data are presented as frequencies and percentages (%), and intergroup differences were compared using the χ^2 test. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Postoperative recovery

The observation group had shorter ICU stays, drainage tube indwelling times, and hospital stays than the control group, with $p < 0.05$. See **Table 1**.

Table 1. Postoperative recovery [$\overline{x} \pm s$]

Group	Number of cases	ICU observation time (h)	Drainage tube indwelling time (d)	Hospital stays (d)
Control group	51	78.12 ± 10.13	5.75 ± 1.59	15.39 ± 2.82
Observation group	51	54.19 ± 8.32	4.32 ± 1.36	11.56 ± 2.23
χ^2 value		13.037	4.881	7.608
p value		< 0.001	< 0.001	< 0.001

3.2. Effective expectoration rate

The effective expectoration rate in the observation group was higher than that in the control group, with $p < 0.05$. See **Table 2**.

Table 2. Effective expectoration rate [n/%]

Group	Number of cases (n)	Effective sputum excretion	Ineffective sputum excretion
Control group	51	35 (68.63)	16 (31.37)
Observation group	51	46 (90.20)	5 (9.80)
χ^2		7.256	
P		0.007	

3.3. Incidence of postoperative pulmonary complications

The overall incidence of postoperative pulmonary complications in the observation group was lower than that in the control group, with $p < 0.05$. See **Table 3**.

Table 3. Incidence of postoperative pulmonary complications [n/%]

Group	Number of cases (n)	Pulmonary infection	Atelectasis	Total incidence
Control group	51	8 (15.69)	5 (9.80)	13 (25.49)
Observation group	51	2 (3.82)	1 (1.96)	3 (5.88)
χ^2				7.413
p				0.006

4. Discussion

Cardiothoracic surgery involves significant trauma, with intraoperative tracheal intubation and manipulation of thoracic organs easily damaging the respiratory mucosa. Coupled with factors such as postoperative incision pain, prolonged bed rest, and decreased respiratory muscle strength, patients commonly experience difficulties in expectorating sputum and sputum retention, thereby substantially increasing the risk of complications such as pulmonary infections and atelectasis. In this study, the control group received routine care, which merely included basic disease monitoring, simple nebulization inhalation, and oral health guidance. The nursing measures were relatively general and lacked systematic, individualized interventions for respiratory management, making it difficult to fundamentally address issues such as poor expectoration and decreased airway defense capabilities in patients, thus revealing shortcomings in nursing interventions [4].

The results of this study showed that the observation group had shorter ICU observation times, drainage tube indwelling times, and hospital stays compared to the control group ($p < 0.05$). The reasons for this are as follows: specialized respiratory care focuses on core aspects such as airway management, expectoration intervention, and respiratory function training, enabling timely airway clearance, reducing the occurrence of pulmonary inflammation, and lowering the probability of secondary pleural effusion and infection. This helps stabilize the patient's vital signs more quickly, shortening the duration of ICU monitoring. Additionally, smooth sputum evacuation and improved pulmonary status contribute to the earlier reduction and achievement of standards for thoracic drainage fluid, shortening the drainage tube indwelling time. Faster recovery of various indicators ultimately effectively reduces the overall hospital stay [5].

The results of this study indicated that the observation group had a higher effective expectoration rate than the control group ($p < 0.05$). The reasons for this are as follows: specialized respiratory care alleviates incision pain through multimodal analgesia, removing the psychological barrier of patients being afraid to cough due to fear of pain. Combined with continuous airway humidification, individualized frequency nebulization therapy to dilute sputum, and physical methods such as postural drainage and standardized chest and back percussion to loosen deep airway sputum, patients are guided step-by-step to master techniques such as abdominal breathing, pursed-lip breathing, and effective coughing based on different types. These multi-pronged approaches comprehensively improve expectoration effectiveness from aspects such as subjective cooperation, sputum characteristics, physical drainage, and respiratory movements, significantly enhancing the effective expectoration rate [6].

The results of this study demonstrated that the observation group had a lower total incidence of postoperative pulmonary infections and atelectasis compared to the control group ($p < 0.05$). The reasons

for this are as follows: sputum retention is a core factor inducing postoperative pulmonary complications in cardiothoracic surgery. A large number of secretions accumulating in the airways easily leads to bacterial growth and compression of lung tissue, thereby triggering pulmonary infections and atelectasis. Specialized respiratory care involves early health education and psychological intervention to improve patient compliance, combined with comprehensive respiratory assessments throughout the process and sterile operation management, forming a complete system for preventing pulmonary infections. This reduces lung tissue compression and inflammatory invasion, lowering the risk of postoperative pulmonary-related complications from the source [7]. Additionally, staged respiratory function training and early activity guidance can gradually restore patients' pulmonary ventilation and gas exchange functions, promoting lung re-expansion and further reducing the incidence of atelectasis [8].

5. Conclusion

In summary, combining specialized respiratory care with routine postoperative care in cardiothoracic surgery can enhance patients' expectoration effectiveness, reduce pulmonary complications, and accelerate postoperative recovery.

Disclosure statement

The author declares no conflict of interest.

References

[1] Wang S, Wang S, 2026, Effects of Comprehensive Nursing on Sputum Expectoration and Pulmonary Infections in Patients After Thoracic Surgery. Chinese Journal of Metallurgical Industry Medicine, 43(1): 106–107.

[2] Chen Q, Mao X, Li H, 2026, Application Effects of Enhanced Recovery After Surgery Concepts in Cardiothoracic Surgery Nursing and Their Impact on Patients' Postoperative Recovery Process. Primary Medical Forum, 30(14): 154–156.

[3] Infectious Diseases Group, Respiratory Diseases Branch, Chinese Medical Association, 2018, Guidelines for the Diagnosis and Treatment of Hospital-Acquired Pneumonia and Ventilator-Associated Pneumonia in Chinese Adults (2018 Edition). Chinese Journal of Tuberculosis and Respiratory Diseases, 41(4): 255–280.

[4] Lin Y, Lin L, Huang M, et al., 2023, Application Value of Multi-Frequency Vibration Sputum Evacuation Device Combined with Specialized Respiratory Care in ICU Patients Undergoing Mechanical Ventilation. Chinese and Foreign Medical Research, 21(18): 101–104.

[5] Sun D, Zhang L, 2023, Effects of Targeted Respiratory Care Combined with Respiratory Specialized Training on Respiratory Function in Lung Cancer Patients After Thoracoscopic Lobectomy. Heilongjiang Medicine Journal, 36(4): 959–962.

[6] Lv X, He Y, Yi Y, et al., 2026, Effects of Personalized Rehabilitation Nursing on Postoperative Respiratory Function Recovery in Critically Ill Patients in Thoracic Surgery. Primary Medical Forum, 30(9): 137–139.

[7] Wang Y, Yang L, 2025, Application Effects of Nursing Interventions Based on Enhanced Recovery After Surgery Concepts in Perioperative Patients Undergoing Thoracic Surgery. Chinese Community Doctors, 41(14): 121–123.

[8] Xu X, Wu Y, 2026, Mechanisms of Refined Respiratory Care on Sputum Evacuation Efficacy and Prevention of

Pulmonary Infections in Patients After Thoracic Surgery. Chinese Medical Journal Database (Citation Edition) Medicine and Health, 2026(3): 160–163.

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Clinical Application of Non-Invasive Dynamic Monitoring of Cerebral Edema Combined with Refined Nursing in Patients with Cerebral Hemorrhage

Jinling Zhao, Tiantian Ye*

Department of Neurosurgery, BenQ Medical Center, Suzhou 215011, Jiangsu, China

Author to whom correspondence should be addressed.

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Abstract: *Objective:* To investigate the clinical application effect of non-invasive dynamic monitoring of cerebral edema combined with refined nursing in patients with cerebral hemorrhage. *Methods:* A prospective study was conducted on 96 patients with cerebral hemorrhage who underwent surgery from October 2024 to January 2026. The patients were randomly divided into two groups using a random number table method. The control group (48 patients) received conventional nursing, while the observation group (48 patients) received non-invasive dynamic monitoring of cerebral edema and refined nursing for a continuous period of 2 weeks. The hematoma volume, cerebral edema volume, adverse emotions, and complication rate were compared between the two groups. *Results:* After 3 days, 1 week, and 2 weeks of nursing, the hematoma volume and cerebral edema volume in the observation group were lower than those in the control group ($p < 0.05$). After 2 weeks of nursing, the adverse emotion scores in the observation group were lower than those in the control group ($p < 0.05$). The complication rate in the observation group was lower than that in the control group ($p < 0.05$). *Conclusion:* Implementing non-invasive dynamic monitoring of cerebral edema and refined nursing in patients with cerebral hemorrhage surgery can reduce hematoma, cerebral edema, adverse emotions, and postoperative complications, demonstrating significant application value.

Keywords: Cerebral hemorrhage; Non-invasive dynamic monitoring of cerebral edema; Conventional nursing; Refined nursing

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1. Introduction

Cerebral hemorrhage is a highly prevalent neurological disease, primarily caused by the rupture of blood vessels within the brain parenchyma [1]. According to a survey, China witnesses over 2 million new cases of

stroke annually, with up to 1.5 million deaths attributed to complications from cerebral hemorrhage [2]. Cerebral edema is a common postoperative manifestation in patients with cerebral hemorrhage, and its occurrence and progression directly affect the degree of neurological damage and prognosis. Cerebral hernia induced by cerebral edema is the leading cause of death in patients with cerebral hemorrhage [3]. Therefore, clinical attention should be heightened towards the monitoring, prevention, and intervention of cerebral edema in patients with cerebral hemorrhage. Combining high-quality nursing with active treatment can accelerate the resolution of cerebral edema, prevent the formation of cerebral hernia, and improve the survival rate of cerebral hemorrhage. Non-invasive dynamic monitoring of cerebral edema is a currently favored monitoring method for cerebral edema, being non-invasive and safe, and highly suitable for severely ill stroke patients [4]. Refined nursing is a novel approach based on traditional nursing, requiring the optimization of clinical nursing plans and refinement of nursing measures to alleviate cerebral hemorrhage symptoms and promote patient recovery through effective nursing. This study analyzed the combined application effect of non-invasive dynamic monitoring of cerebral edema and refined nursing.

2. Materials and methods

2.1. General information

Ninety-six patients with cerebral hemorrhage who underwent surgery at the hospital from October 2024 to January 2026 were included in the study.

2.1.2. Inclusion criteria

(1) Meeting the diagnostic criteria in the "Guidelines for the Prevention and Treatment of Cerebrovascular Diseases (2024 Edition)" [5];
(2) First onset and first surgical treatment;
(3) Able to undergo non-invasive dynamic monitoring of cerebral edema and communicate normally after regaining consciousness;
(4) Informed consent to participate in the study.

2.1.3. Exclusion criteria

(1) Concomitant malignant tumors;
(2) Concomitant cerebral infarction;
(3) Concomitant severe infections;
(4) Concomitant coagulation disorders;
(5) Audiovisual impairments;
(6) Death before the study.

2.1.4. Study design

The 96 patients were randomly divided into two groups using a random number table method, with 48 patients in each group.

(1) Control group

27 males and 21 females, aged 54–79 years (66.92 ± 3.11 years), with a hemorrhage volume of 8–30 mL (19.37 ± 3.06 mL), including 18 cases of ventricular hemorrhage, 16 cases of basal ganglia hemorrhage, 7

cases of lobar hemorrhage, and 7 cases of thalamic hemorrhage.

(2) Observation group

26 males and 22 females, aged 56–78 years (67.38 ± 3.25 years), with a hemorrhage volume of 8–31 mL (19.78 ± 3.17 mL), including 20 cases of ventricular hemorrhage, 16 cases of basal ganglia hemorrhage, 6 cases of lobar hemorrhage, and 6 cases of thalamic hemorrhage. No significant differences were observed in the comparison of various data between the two groups ($p > 0.05$).

2.2. Methods

2.2.1. Control group

(1) Conventional nursing

Close monitoring of changes in consciousness and mental state was conducted. If symptoms such as restlessness and mental confusion were observed, physicians were immediately notified for treatment. Maintaining airway patency and timely oxygen administration were essential, while precautions were taken to prevent complications such as asphyxia and aspiration pneumonia. For comatose patients, their heads were required to be turned to one side, and they were assisted in changing positions regularly. During the acute phase, patients were required to abstain from food completely. Once their condition stabilized, they were provided with full-liquid and semi-liquid foods, with dietary types adjusted according to their condition. Patients were also encouraged to drink plenty of water to dilute their blood and prevent rebleeding adequately. After stabilization, patients were encouraged to engage in early rehabilitation exercises to restore bodily functions through passive and active limb exercises.

2.2.2. Observation group

(1) Non-invasive dynamic monitoring of cerebral edema

Continuous dynamic monitoring was performed using a non-invasive cerebral edema monitor. Two electrode patches were affixed to the left and right temporal regions, respectively. The center (button) of the rear electrode patch was aligned with the highest point of the auricle above the external auditory meatus, with the lower edge of the electrode patch coinciding with the extension line of the outer canthus. The front electrode patch was placed adjacent and parallel to the rear one, adhered using the “rice character” method. Before adhesion, the skin was carefully cleaned, hair was removed, and the area was thoroughly dried. The four electrode patches were symmetrically placed on both sides, with the front right electrode patch connected to the brown lead wire and the rear right electrode patch connected to the green lead wire; the front left electrode patch was connected to the black lead wire, and the rear left electrode patch was connected to the white lead wire. The cerebral electrical impedance perturbation coefficient was recorded, with normal values ranging from 6 to 8, cerebral edema formation from 9 to 12, and severe cerebral edema/cerebral hernia formation exceeding 12. The difference in detection values between the left and right cerebral hemispheres was less than 0.3.

(2) Refined Nursing

Vital Sign Management: After surgery, vital signs such as blood oxygen saturation, body temperature, heart rate, and blood pressure were closely monitored. Measurements were taken and recorded every 30 minutes until stability was achieved, after which they were monitored every 2 hours. Depending on the patient’s condition, the frequency of monitoring was gradually reduced to once every 2 days. - Position

Management: After surgery, patients were transferred to the ward and required to rest in bed. The most appropriate position was selected based on the severity of the condition and the size of the surgical incision. The head of the bed was elevated by 15° to 30°to promote venous blood return, reduce intracranial pressure, and alleviate cerebral edema. If the patient had not regained consciousness, a horizontal supine position with the head slightly turned to the side was required to prevent aspiration and asphyxia. - Emotional Management: After the patient regained consciousness, their emotional state was actively evaluated to identify adverse emotions and analyze their causes. Doubts were actively addressed, emotions were soothed, and potential issues were eliminated. Daily communication with the patient helped alleviate adverse emotions, and successful rehabilitation cases were cited to boost treatment confidence. Once the patient's condition permitted, family members were encouraged to accompany them, providing care and affection to regulate their emotional state continuously. If necessary, successfully operated and well-rehabilitated patients were invited to share their experiences to enhance rehabilitation confidence. If the patient's adverse emotions were severe and persisted, a professional psychologist was invited to intervene and regulate their psychological state. - Complication Prevention: Close attention was paid to the patient's postoperative performance, and effective measures were actively taken to prevent complications such as infection, pressure injuries, and deep vein thrombosis. Nurses evaluated the risk of complications daily and adjusted nursing measures based on the assessment results to ensure targeted care.

2.3. Observation indicators

(1) Hematoma volume

The largest hematoma area was selected, and the major and minor diameters were measured. Hematoma volume = $\pi/6$ × major diameter × minor diameter × slice thickness × number of hematoma slices.

(2) Cerebral edema volume

The total lesion volume was calculated using the same method as for hematoma volume. The difference between the total lesion volume and the hematoma volume represented the edema volume.

(3) Adverse emotions

The Hamilton Anxiety Scale and the Hamilton Depression Scale were used for evaluation [6,7]. Scores > 7 indicated the presence of anxiety/depressive emotions, with higher scores indicating more severe adverse emotions.

(4) Complication rate

The total incidence of infection, pressure injuries, and deep vein thrombosis was statistically analyzed.

2.4. Statistical methods

SPSS 27.0 was used for comparison. Measurement data (conforming to normal distribution) were presented as ($\overline{x} \pm s$) and subjected to *t*-tests. Count data were presented as frequencies (%) and subjected to χ^2 tests. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of hematoma volume and cerebral edema volume between the two groups

After 3 days, 1 week, and 2 weeks of nursing, the hematoma volume and cerebral edema volume in the observation group were lower than those in the control group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of hematoma volume and cerebral edema volume between the two groups ($\overline{x} \pm s$, mL)

Group	Number of cases	Hematoma volume				Brain edema volume			
		Before nursing	3 d after nursing	1 week after nursing	2 weeks after nursing	Before nursing	3 d after nursing	1 week after nursing	2 weeks after nursing
Observation group	48	25.87 ± 2.66	21.06 ± 2.14[a]	17.85 ± 2.24[a]	12.01 ± 2.05[a]	10.12 ± 3.11	21.65 ± 3.56[a]	33.86 ± 4.25[a]	20.16 ± 4.34[a]
Control group	48	25.34 ± 2.50	23.15 ± 2.31[a]	20.08 ± 2.28[a]	16.53 ± 2.17[a]	10.56 ± 3.28	25.08±3.64[a]	37.65 ± 4.47[a]	25.37 ± 4.59[a]
t value	–	1.006	4.598	4.834	10.490	0.674	4.667	4.257	5.714
p value	–	0.317	< 0.001	< 0.001	< 0.001	0.502	< 0.001	< 0.001	< 0.001

Note: Compared with the pre-nursing state within the same group, [a]$p < 0.05$.

3.2. Comparison of adverse emotions between the two groups

After 2 weeks of nursing, the adverse emotion scores in the observation group were lower than those in the control group ($p < 0.05$). See **Table 2**.

Table 2. Adverse emotions in both groups (points)

Group	Number of cases	Anxiety		Depression	
		Before nursing	2 weeks after nursing	Before nursing	2 weeks after nursing
Observation group	48	10.98 ± 2.26	6.23 ± 1.53[a]	12.76 ± 2.49	7.05 ± 1.45[a]
Control group	48	10.54 ± 2.13	7.98 ± 1.74[a]	12.42 ± 2.35	8.66 ± 1.69[a]
t value	-	0.982	5.233	0.688	5.009
p value	-	0.329	< 0.001	0.493	< 0.001

Note: Compared with the pre-nursing care in the same group, [a]$p < 0.05$.

3.3. Comparison of complication rates between the two groups

The complication rate in the observation group was lower than that in the control group ($p < 0.05$). See **Table 3**.

Table 3. Complication rates in the two groups (n/%)

Group	Number of cases	Infection (n)	Pressure injury (n)	Deep vein thrombosis (n)	Complication rate (%)
Observation group	48	1	1	0	4.17
Control group	48	4	2	2	16.67
χ^2 value	-	-	-	-	4.019
p value	-	-	-	-	0.045

4. Discussion

Cerebral edema is a secondary change triggered by cellular energy metabolism disorders resulting from ischemia and hypoxia after brain tissue damage [8]. Severe cerebral edema can form a mass effect, impacting the function of normal brain tissue. If severe cerebral edema continues to progress, it can cause irreversible

damage and threaten the patient's life. In the past, the severity of cerebral edema was often assessed through imaging examinations, symptom manifestations, and previous experience, which could easily delay the diagnosis and treatment. Previously, intracerebroventricular catheterization was commonly used to monitor cerebral edema, but it is invasive and difficult for patients to tolerate, and may even lead to complications. Although simple imaging examinations can show the location and specific size of cerebral edema, they cannot provide real-time and dynamic monitoring. Therefore, it is necessary to combine other monitoring methods to obtain the most accurate monitoring results. Non-invasive dynamic cerebral edema monitoring can utilize the principle of foreign object disturbance, the theory of bioelectromagnetic fields, and impedance imaging technology to dynamically monitor the water content in brain tissue, accurately evaluate the severity of cerebral edema, and guide clinical treatment and nursing care [9]. In recent years, refined nursing has been widely applied in neurology, requiring a patient-centered approach and optimizing, refining, and elaborating clinical nursing measures according to the type and severity of the disease to enhance nursing effects.

This study found that compared with the control group, the observation group had lower hematoma volume and cerebral edema volume, lower scores for adverse emotions, and a lower incidence of postoperative complications, suggesting that non-invasive dynamic cerebral edema monitoring combined with refined nursing can alleviate cerebral hemorrhage conditions, improve patients' emotional states, and prevent postoperative complications. The reason is that non-invasive dynamic cerebral edema monitoring can collect electromagnetic signal differences between normal and damaged brain tissues and accurately reflect the dynamic changes in intracranial brain tissue of patients through disturbance coefficients. It is a real-time, safe, and non-invasive monitoring technology that can comprehensively assess the development trend of cerebral edema in patients and identify secondary lesions such as cerebral hernia [10]. Refined nursing has various advantages such as being meticulous, comprehensive, and scientific, which can improve the quality of clinical nursing, prevent related complications, and promote patients' early recovery. The combination of non-invasive dynamic cerebral edema monitoring and refined nursing can guide nurses to grasp the severity of cerebral edema in patients in real time, adjust nursing measures according to patients' actual needs, and fully leverage the targeted and scientific advantages of nursing to ensure nursing effects and quality.

5. Conclusion

In summary, the combined implementation of non-invasive dynamic cerebral edema monitoring and refined nursing in patients with cerebral hemorrhage can reduce hematoma and cerebral edema, alleviate adverse emotions, and prevent postoperative complications, making it worthy of clinical promotion.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Shen P, Huang P, Yu J, 2023, Effects of Nursing Mode Graded According to NIHSS Score on Postoperative Neurological and Limb Functions in Patients with Cerebral Hemorrhage. International Journal of Nursing, 42(4): 724–728.

[2] Zhou J, Zhang L, Miao Z, 2023, Effects of Motivational Nursing on Adverse Emotions, Quality of Life, and Self-Efficacy in Patients Undergoing Rehabilitation After Hypertension-Induced Cerebral Hemorrhage. International Journal of Nursing, 42(1): 43–46.

[3] Gao R, Chen Z, Li L, 2023, Effects of Failure Mode and Effect Analysis Nursing on Risk Coefficient Values, Psychosocial Adaptation, and Quality of Life in Patients with Hypertension-Induced Cerebral Hemorrhage. International Journal of Nursing, 42(21): 3991–3995.

[4] Jia Y, Wu M, 2023, Effects of Stepped Nursing Mode Based on Multidisciplinary Concepts on Cognitive Function and Psychological State in Patients with Acute Cerebral Hemorrhage. International Journal of Nursing, 42(4): 716–718.

[5] National Health Commission of the People's Republic of China, 2025, Guidelines for the Prevention and Treatment of Cerebrovascular Diseases (2024 Edition). Magnetic Resonance Imaging, 16(1): 1–8.

[6] Nie H, Lu Y, 2024, Application of Roy-Neuman Comprehensive Model Nursing Intervention Combined with Compression Stockings in the Perioperative Period of Patients Undergoing Cerebral Hemorrhage Surgery and Its Preventive Effect on DVT. International Journal of Nursing, 43(12): 2206–2210.

[7] Qin L, Zhang Y, Liu R, et al., 2023, Application of Bundled Nursing Based on the Principles of Hazard Analysis and Critical Control Points in Patients with Hypertension-Induced Cerebral Hemorrhage. Journal of Clinical and Pathological Research, 43(2): 388–393.

[8] Cheng J, Mao H, 2023, Preventive Effect of Nursing Risk Management Combined with Oral Intervention on Postoperative Ventilator-Associated Pneumonia in Elderly Patients with Hypertension-Induced Cerebral Hemorrhage. Journal of North Sichuan Medical College, 38(9): 1286–1289.

[9] Chen P, Gao W, Jiang X, et al., 2024, Application Value of Non-Invasive Dynamic Cerebral Edema Monitor in Predicting Intracranial Pressure After Cerebral Hemorrhage in Rats. Clinical Research and Practice, 9(33): 13–17.

[10] Hu X, Zhou Y, Cai L, et al., 2023, Analysis of the Application Value of Non-Invasive Dynamic Cerebral Edema Monitor in Monitoring Patients with Hemorrhagic Stroke. Chinese Journal of Preventive Medicine, 25(6): 630–633.

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Applied Research on Feedforward Control Nursing Intervention to Improve Patient Satisfaction in the Post-Anesthesia Care Unit

Peipei Wu, Yaping Wang

Xinghua People's Hospital, Kangda College of Nanjing Medical University, Taizhou 225700, Jiangsu, China

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Abstract: *Objective:* To explore and analyze the effectiveness of implementing feedforward control nursing interventions in patients undergoing general anesthesia surgery. *Methods:* A total of 100 patients who underwent general anesthesia surgery in our hospital were selected as the study subjects. The reference group received routine nursing care, while the study group received feedforward control nursing interventions. The nursing effects were observed. *Results:* The nursing effects and related indicators in the study group were better than those in the reference group ($P < 0.05$). *Conclusion:* Implementing feedforward control nursing interventions in patients undergoing surgery can effectively accelerate their postoperative recovery, help them recover from the effects of anesthesia more quickly, improve their prognosis, and significantly increase their satisfaction.

Keywords: General anesthesia surgery; Feedforward control nursing; Anesthesia recovery; Satisfaction

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1. Introduction

The Post-Anesthesia Care Unit (PACU) is a critical location for patients undergoing general anesthesia surgery to recover from anesthesia, monitor vital signs, and prevent complications. During the postoperative anesthesia recovery period, patients are prone to adverse reactions such as respiratory depression, agitation, pain, and hypothermia. Additionally, anxiety and fear due to uncertainty about the surgical outcome and recovery process not only affect the quality of anesthesia recovery but also reduce patient satisfaction with nursing care [1]. Currently, clinical PACU nursing often adopts an empirical routine nursing model, primarily responding passively to problems that arise in patients, lacking proactive and targeted preventive measures, and struggling to meet patients' individualized recovery needs fully, thus necessitating further improvement in nursing quality [2]. Feedforward control is a proactive management model that focuses on identifying potential problems in advance, formulating targeted preventive measures, and intervening before problems occur to prevent adverse events [3]. Applying the concept of feedforward control to PACU nursing work can

improve patients' recovery experiences and increase nursing satisfaction by proactively identifying potential risks during anesthesia recovery and developing personalized intervention plans to achieve proactive prevention and precise intervention in nursing work [4]. Therefore, this article aims to explore and analyze the effectiveness of implementing feedforward control nursing interventions in patients undergoing surgery.

2. Materials and methods

2.1. General information

A total of 100 patients who underwent general anesthesia surgery in our hospital from September 2024 to August 2025 were selected as the study subjects. They were evenly divided into two groups using a random number table method, with 50 cases in each group. The male-to-female ratio in the study group was 27:23, with ages ranging from 32 to 58 years and an average age of (45.62 ± 6.42) years. The male-to-female ratio in the control group was also 27:23, with ages ranging from 31 to 59 years and an average age of (45.35 ± 6.55) years. The differences in baseline data between the two groups were small ($p > 0.05$).

2.2. Methods

The control group received routine nursing care: After the patient was transferred to the PACU, vital signs (body temperature, blood pressure, heart rate, and blood oxygen saturation) were monitored every 5 minutes. Close observation was made of the incision drainage, intravenous infusion, and urine output. Medication reactions were recorded, and any abnormalities were promptly reported to the doctor and handled. Routine position care and catheter care were performed, and patients were informed of postoperative precautions to meet their basic nursing needs.

The study group received feedforward control nursing interventions in addition to routine nursing care:

(1) Preoperative psychological intervention and health education

Patients were visited before anesthesia, and a one-on-one communication method was used to introduce the anesthesia method, surgical process, and PACU recovery process to the patients, answer their questions about surgery and anesthesia, and alleviate their tension. A PACU promotional video was played to allow patients to visually understand the nursing operations, precautions, and possible discomfort during the recovery period, eliminating their fear of the unknown and improving their cooperation.

(2) Precise monitoring of anesthesia depth

For patients with longer surgical times or poorer physical conditions, the bispectral index (BIS) was continuously monitored to observe the patient's anesthesia depth dynamically. Based on changes in the BIS value and the patient's respiratory status, the respiratory mode was adjusted, and the timing of extubation was accurately judged to avoid adverse reactions caused by premature or delayed extubation.

(3) Precise pain intervention

After the patient was transferred to the PACU, the pain numerical rating scale (NRS) was used to assess the patient's pain level every 30 minutes continuously. When the NRS score was ≥ 4, sedative and analgesic drugs were promptly administered according to the doctor's advice. After medication, the patient's response was closely observed, and the dosage and plan were adjusted according to the pain score to ensure that the pain was controlled within a reasonable range and reduce the impact of pain on the patient's recovery.

(4) Temperature protection intervention

The risk of hypothermia was assessed in advance. For elderly, frail patients or those with surgical times

exceeding 1 hour, a fluid warmer and warming blanket were used for insulation. Patients were routinely covered with cotton quilts, and their body temperature was monitored every 30 minutes to promptly detect hypothermia and take intervention measures to avoid complications such as shivering and arrhythmia caused by hypothermia.

(5) Agitation prevention and catheter care

The patient's limbs were reasonably restrained, and various catheters and drainage tubes were properly fixed to avoid tube dislodgement. The PACU environment was kept quiet, and noise and strong light stimulation were controlled. For patients with a clear tendency toward agitation, psychological comfort was promptly provided. When extubation indications were met, extubation was performed in a timely manner to avoid agitation caused by adverse stimuli.

(6) Humanistic care and position care

After the patient regained consciousness, humanistic care was strengthened. Active communication was initiated with the patient to inform them that the surgery was completed and to alleviate their anxiety. Reasonable demands of the patient were met as much as possible. When the patient's condition allowed, the head of the bed was elevated by 15–30 degrees to promote smooth breathing and prevent pulmonary infections.

2.3. Observation indicators

2.3.1. Time consumed for anesthesia recovery

Record the time for the recovery of spontaneous breathing, eye-opening, tracheal tube removal, and the duration of stay in the Post-Anesthesia Care Unit (PACU) for both groups.

2.3.2. Patient satisfaction

Utilize the Anesthesia Department's postoperative & PACU patient satisfaction questionnaire, administered on the first postoperative day. The satisfaction dimensions are categorized as very satisfied, satisfied, neutral, and dissatisfied. The overall satisfaction rate among hospitalized patients is calculated as (very satisfied + satisfied) / number of cases × 100%.

2.4. Statistical analysis

All data generated from this experiment were analyzed using SPSS 26.0 software. Measurement data and count data are presented as "$\overline{x} \pm s$" and "%", respectively. Comparisons between groups were conducted using *t*-tests and chi-square tests (χ^2). Statistical significance is considered when $p < 0.05$.

3. Results

3.1. Comparison of time consumed for anesthesia recovery

The time consumed for anesthesia recovery in the study group was shorter than that in the reference group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of time consumed for anesthesia recovery ($\overline{x} \pm s$)

Group	n	Spontaneous breathing recovery time (minutes)	Eye-opening time (minutes)	Tracheal tube extubation time (minutes)	PACU stay time (minutes)
Study group	50	8.04 ± 1.75	10.35 ± 2.06	15.23 ± 2.18	68.15 ± 9.67
Reference group	50	12.15 ± 2.39	15.34 ± 2.51	25.26 ± 3.26	85.64 ± 11.26
t	/	9.810	10.866	18.084	8.332
p	/	0.000	0.000	0.000	0.000

3.2. Comparison of nursing satisfaction

The nursing satisfaction in the study group was higher than that in the reference group ($p < 0.05$). See **Table 2**.

Table 2. Comparison of nursing satisfaction [n/(%)]

Group	n	Very satisfied	Satisfied	General	Dissatisfied	Total satisfaction rate
Study group	50	32 (64.00)	16 (32.00)	2 (4.00)	0 (0.00)	48 (96.00)
Control group	50	21 (42.00)	18 (36.00)	7 (14.00)	4 (8.00)	39 (78.00)
χ^2	/	/	/	/	/	7.161
p	/	/	/	/	/	0.007

4. Discussion

The anesthesia recovery phase in patients undergoing general anesthesia surgery is a period of high nursing risk. During this stage, as patients' physiological functions such as consciousness, respiration, and circulation have not fully recovered, they are prone to a series of issues including restlessness, hypothermia, unplanned extubation, and inadequate pain control. These problems not only affect the postoperative recovery process but also easily trigger various complications, increasing patient suffering and healthcare burdens [5]. Conventional nursing primarily adopts a "reactive response" approach, intervening only after problems arise, making it difficult to avoid risks fundamentally. In contrast, feedforward control nursing intervention, as a "proactive prevention and early intervention" nursing model, is guided by patients' potential nursing risks. By identifying risk factors in advance, formulating targeted prevention and control plans, and standardizing nursing procedures, it achieves comprehensive control over the nursing process. This approach demonstrates significant advantages in the nursing of patients undergoing general anesthesia surgery, effectively compensating for the deficiencies of conventional nursing and providing solid guarantees for patients' safe recovery [6].

The core advantage of feedforward control nursing intervention lies in its ability to identify nursing risks in advance and achieve front-end risk prevention and control, thereby reducing the incidence of adverse events at their source. The nursing risks in patients undergoing general anesthesia surgery are characterized by concealment and suddenness. In conventional nursing, nurses often focus on monitoring patients' postoperative vital signs and lack systematic identification and anticipation of potential risks. They typically address risk events only after they occur, which has already impacted patients' recovery to some extent. In contrast, feedforward control nursing intervention emphasizes "prevention first". Before patients enter the anesthesia recovery room, nurses comprehensively review potential nursing risk points based on individual

patient factors such as age, constitution, surgical type, and anesthesia method. These risk points include delayed anesthesia recovery, respiratory depression, restlessness, catheter dislodgement, hypothermia, and increased pain. They analyze the causes of risk occurrence, such as a weak constitution leading to delayed recovery, prolonged surgery time contributing to hypothermia, and insecure catheter fixation resulting in unplanned extubation. Based on this analysis, personalized prevention plans are formulated for various potential risks, and early intervention measures are taken to nip risks in the bud, preventing adverse events and maximizing patient safety [7].

Feedforward control nursing intervention establishes a comprehensive nursing procedure system, standardizing various nursing operations during anesthesia recovery. It clarifies operational procedures, standards, and responsibilities, formulating detailed operational guidelines for every aspect, from patient admission assessment, vital sign monitoring, catheter care, and positioning care to psychological nursing, pain nursing, and temperature protection. This ensures that every nursing measure is carried out with clear rules and evidence-based practices [8]. Simultaneously, through systematic training for nurses, their mastery of nursing procedures and operational standards is enhanced, improving the proficiency and accuracy of nursing operations and reducing nursing errors. Additionally, feedforward control nursing intervention emphasizes control over nursing details. For example, in catheter care, nurses not only focus on catheter fixation but also assess patients' restlessness risk in advance and take reasonable restraint measures to prevent catheter dislodgement due to patient agitation. In temperature protection, based on patients' constitution and surgical conditions, nurses take proactive insulation measures to prevent hypothermia, making nursing services more targeted and refined and comprehensively improving nursing quality.

Patients undergoing general anesthesia surgery often experience varying degrees of anxiety and fear before surgery, worrying about surgical outcomes, anesthesia safety, and postoperative pain. During the anesthesia recovery phase after surgery, patients may exhibit negative emotions such as restlessness and anxiety due to factors like unclear consciousness, physical discomfort, and unfamiliar environments. These emotions not only affect patients' recovery mindset but may also lead to non-cooperation with nursing operations, increasing nursing difficulty [9]. Feedforward control nursing intervention fully considers patients' psychological states and integrates psychological nursing throughout the entire nursing process. Before anesthesia, nurses visit patients, providing detailed information about anesthesia methods, procedures, precautions, and postoperative recovery knowledge. They patiently answer patients' questions, alleviating preoperative anxiety and fear and gaining patients' trust and cooperation. After patients enter the anesthesia recovery room, nurses promptly communicate with them, informing them that the surgery has been completed, explaining the current recovery situation, and providing emotional comfort and humanistic care. They create a quiet and comfortable recovery environment for patients, avoiding adverse stimuli and alleviating restlessness. Simultaneously, nurses actively attend to patients' needs, fulfilling reasonable requests as much as possible, making patients feel respected and cared for, enhancing their healthcare experience, and increasing nursing compliance. This enables patients to actively cooperate with various nursing operations and promotes postoperative recovery [10].

By proactively preventing adverse events and reducing the incidence of complications, feedforward control nursing intervention decreases the nursing resources required to manage complications and reduces nursing workload. Simultaneously, by standardizing nursing procedures and clarifying responsibilities, it avoids redundant labor and ineffective operations in nursing work, improving nursing efficiency and

allowing nurses to devote more time and energy to personalized patient care. Moreover, through training and assessment of nurses, feedforward control nursing intervention enhances nurses' professional competence and emergency response capabilities, preventing nursing errors and reducing medical disputes and costs associated with nursing errors. Additionally, the accelerated recovery process shortens patients' stay in the anesthesia recovery room, improving bed utilization rates and achieving reasonable allocation and efficient utilization of nursing resources, promoting the scientific and standardized development of nursing work.

5. Conclusion

In summary, implementing feedforward control nursing intervention in patients undergoing surgical treatment can effectively accelerate their postoperative recovery, help them recover more quickly from the effects of anesthesia drugs, improve their prognosis, and significantly enhance their satisfaction.

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References

[1] Pang L, Ouyang T, Zhou N, 2025, Application of Composite Insulation Nursing Based on Feedforward Control Risk in Elderly Fracture Patients. China Medical Innovation, 22(30): 81–84.

[2] Zhong J, Li R, 2025, Effect of Feedforward Control Nursing Intervention on the Recovery Quality of Patients Undergoing Otolaryngological Tracheal Intubation Surgery. Heilongjiang Medicine Journal, 38(03): 725–728.

[3] Xu K, 2025, Analysis of the Impact of Nursing Intervention Based on Feedforward Control on Pain and Restlessness During the Recovery Period of Female Patients Undergoing General Anesthesia Surgery in PACU. Marriage and Health, 31(12): 187–189.

[4] Zhang L, Li X, Dai Q, 2025, Application of Feedforward Control Theory in the Nursing of Patients with Agitation During Anesthesia Recovery. Hebei Medical Journal, 47(03): 517–520 + 524.

[5] Chen Y, Yan Z, Wang Q, et al., 2024, Clinical Effects of Feedforward Control Nursing Intervention on Restlessness and Recovery Quality During the Recovery Period of Patients Undergoing General Anesthesia Surgery. Journal of Practical Clinical Medicine, 28(19): 140–144.

[6] Li W, Xia X, Zhang W, et al., 2024, Application of Feedforward Control Nursing Intervention in Anesthesia Recovery Management of Patients Undergoing Robot-Assisted Thoracoscopic Radical Resection of Lung Cancer. China Modern Doctor, 62(15): 37–41.

[7] Huang D, Wang Y, Hong B, et al., 2023, Application of Nursing Intervention Based on Feedforward Control in Reducing Adverse Reactions After Anesthesia Gastrointestinal Endoscopy. Chinese Journal of Geriatric Health Care Medicine, 21(05): 158–160.

[8] Kuang Q, Li B, Wu K, 2023, Effects of Feedforward Control Combined With Composite Insulation Measures on Restlessness and Body Temperature During the Recovery Period After General Anesthesia. General Nursing, 21(25): 3524–3527.

[9] Meng L, Wu S, 2023, Impact of Nursing Intervention Based on Feedforward Control on Pain and Restlessness

During the Recovery Period of Patients Undergoing General Anesthesia Surgery in PACU. Journal of Practical Integrated Traditional Chinese and Western Medicine, 23(14): 125–128.

[10] Xu D, 2023, Application Effect of Feedforward Control in Anesthesia Recovery of Patients Undergoing General Anesthesia. Chinese Journal of Health Preservation, 41(10): 164–166 + 173.

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Research Progress on New Non-invasive Diagnostic Techniques and Long-term Refined Management Strategies for Childhood Asthma

Ying Guo, Jijing Han*

Department of Hepatobiliary Surgery, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China.

Author to whom correspondence should be addressed.

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Abstract: Childhood bronchial asthma has clinical characteristics of strong heterogeneity, prolonged course, and easy recurrence of acute attacks. The atypical symptoms of preschool children and low cooperation with traditional testing have led to prominent problems such as early missed diagnosis, misdiagnosis, and poor long-term management. Traditional invasive and highly cooperative diagnostic methods are difficult to adapt to the physiological characteristics of children. The new non-invasive diagnostic technology, with its advantages of safety, convenience, and repeatable testing, gradually achieves early screening, inflammation classification, and risk prediction of asthma. At the same time, the traditional extensive management model cannot adapt to the individualized diagnosis and treatment needs of children with different phenotypes. Fine, full-cycle, and intelligent management has become the core direction of childhood asthma prevention and control. This article systematically reviews the clinical application value of new non-invasive diagnostic technologies for childhood asthma, covering cutting-edge technologies such as airway inflammation detection, respiratory acoustic monitoring, and intelligent assisted diagnosis. This article summarizes the research progress on refined long-term management strategies such as hierarchical classification, remote home monitoring, and physical and mental collaboration, providing an evidence-based reference for standardized and individualized comprehensive management of pediatric asthma.

Keywords: Childhood bronchial asthma; Non-invasive diagnosis; Precise diagnosis and treatment; Refined management; Disease monitoring

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1. Introduction

Childhood bronchial asthma is the most common chronic respiratory heterogeneity disease in pediatrics. In recent years, the incidence of childhood asthma in China has continued to rise, with the proportion of young children affected increasing year by year, seriously affecting their growth and development, physical

and mental health, and quality of family life. Childhood asthma has become one of the key chronic diseases for prevention and control in pediatrics [1]. Early identification, diagnosis, and long-term management of asthma are key to reducing the incidence of acute attacks, minimizing irreversible damage to lung function, and improving long-term prognosis. At present, the general clinical pulmonary function test has high requirements for the cooperation of young children, and the compliance of invasive detection methods is poor. It is difficult to achieve repeated dynamic monitoring, resulting in some children with atypical asthma and occult airway inflammation unable to be diagnosed and intervened in time. At the same time, the traditional unified management model ignores the individual differences of patients' age, allergic phenotype, inflammation level, and psychological state, resulting in unbalanced long-term control effect and insufficient standardization of primary diagnosis and treatment. With the development of respiratory medicine and intelligent medical technology, various new non-invasive diagnostic technologies have broken through the limitations of traditional diagnosis and treatment. They can accurately assess the state of airway inflammation and the degree of airflow limitation, and provide an objective basis for early diagnosis and classification [2,3]. The long-term refined management strategy based on accurate diagnosis breaks the single drug control mode and realizes the personalized regulation of the whole process of screening, diagnosis, intervention, and follow-up. Based on the research results of core journals at home and abroad in recent years and the latest diagnosis and treatment guidelines, this article systematically summarizes the application advantages and applicable scenarios of new non-invasive diagnostic techniques for childhood asthma. This article outlines the core content and clinical value of a refined long-term management system, analyzes existing problems, and looks forward to future development directions. This article provides theoretical support for optimizing the whole process diagnosis and treatment system of childhood asthma and improving clinical management and control level.

2. New non-invasive diagnostic technology

2.1. Non-invasive detection technology for inflammatory markers in exhaled breath

Fractional exhaled nitric oxide (FeNO) is an indicator for evaluating airway inflammation. Its expression level is positively correlated with airway inflammation and is commonly used in the diagnosis and treatment of respiratory diseases such as asthma. It plays an important role in evaluating therapeutic efficacy and can serve as a basis for improving the condition [4]. Compared to traditional lung function testing, FeNO detection is simple to operate, does not require deliberate cooperation, and can quickly quantify the degree of airway inflammation, distinguish asthma from ordinary wheezing, and cough caused by respiratory infections. Deng Dandan et al.'s research has confirmed that the sensitivity and specificity of FeNO in diagnosing allergic asthma in children can reach over 85%, which can effectively screen for occult asthma and subclinical airway inflammation, providing a basis for early intervention [5]. During long-term follow-up, dynamic FeNO monitoring can predict the risk of acute asthma attacks, guide individualized reduction or maintenance treatment of glucocorticoids, and avoid recurrence of the condition caused by blind discontinuation of medication. In addition to FeNO, exhaled breath condensate (EBC) detection can collect inflammatory factors and oxidative stress indicators in airway secretions, comprehensively evaluate the status of airway microinflammation, and compensate for the limitations of single FeNO detection. It is suitable for auxiliary diagnosis of difficult-to-classify and treat asthma in children, and has gradually been applied in pediatric

clinical research and precision diagnosis and treatment [6].

2.2. Intelligent respiratory acoustic monitoring technology

Intelligent acoustic auscultation and wheezing intelligent recognition technology have become new non-invasive diagnostic breakthroughs for preschool children who cannot cooperate with routine lung function testing. The artificial intelligence acoustic recognition system based on convolutional neural networks and recurrent neural networks can collect children's respiratory sounds through smartphones and smart stethoscopes. It can automatically identify features such as wheezing, stridor, and abnormal respiratory rhythms, and accurately distinguish between physiological wheezing and pathological wheezing [7]. This technology does not require active cooperation from the child and is suitable for early screening of children aged 0-6 years old. It effectively solves the clinical problem of a high missed diagnosis rate of asthma in young children. Research shows that the accuracy of artificial intelligence respiratory acoustic detection in identifying asthma attacks in children is significantly higher than that of artificial auscultation. Artificial intelligence respiratory acoustic detection can capture mild and intermittent wheezing symptoms, enabling real-time screening and dynamic monitoring at home. This provides a convenient means for primary screening of asthma at the grassroots and family levels, greatly expanding the coverage of early diagnosis of childhood asthma [8].

2.3. Simplified non-invasive detection technology for lung function

The traditional forced pulmonary function test requires a high degree of cooperation from children, and the success rate of children is less than 50 %. The new simplified non-invasive lung function technology effectively fills this gap. Tidal respiration lung function testing does not require the child to breathe forcefully. It relies on natural breathing to obtain core indicators such as respiratory rate, tidal volume, and peak time ratio, accurately evaluating the functional status of small airways. This is the core non-invasive technology for asthma screening in preschool children [9]. In addition, the Peak Expiratory Flow (PEF) home dynamic monitoring technology is easy to operate and can be repeatedly tested at home. By using the variation rate of PEF during the day and night to determine airway hyperresponsiveness, this technique can differentiate between exercise-induced asthma and nocturnal asthma. This technology can dynamically track changes in airway ventilation function, compensate for the limitations of single laboratory testing, provide continuous objective data for asthma grading and efficacy evaluation, and adapt to the long-term dynamic diagnosis and treatment needs of children [10].

2.4. Multi-omics non-invasive joint screening technology

With the development of precision medicine, the combined screening system based on non-invasive markers of peripheral blood is gradually improving. It provides a new direction for the classification and diagnosis of asthma in children. Non-invasive indicators such as peripheral blood eosinophil count, total IgE, and specific allergen screening can be combined with airway inflammation detection and lung function indicators to construct a multidimensional diagnostic model for asthma, clarify the allergy phenotype and inflammation classification of children, and distinguish between eosinophilic and non-eosinophilic asthma [11]. Compared to a single detection method, multi-omics combined screening can significantly improve the diagnostic accuracy of childhood asthma while avoiding invasive testing risks [12]. This technology system can accurately identify

high-risk children, predict the severity of the condition and the risk of recurrence, and provide an objective basis for the development of refined and personalized treatment plans in the future. This technology system has been widely applied in the classification, diagnosis, and risk stratification management of childhood asthma.

3. Refined management strategies

3.1. Phenotypic-based hierarchical classification management strategy

Childhood asthma has high heterogeneity, and a unified management plan is difficult to adapt to the disease characteristics of different children. Layered management based on clinical phenotype and inflammation classification is the core of refined diagnosis and treatment. Clinically, patients can be accurately stratified based on their age, triggering factors, type of inflammation, and severity of the condition. We can classify the condition into different management levels, such as mild intermittent, mild persistent, and moderate-to-severe persistent. Based on this, they can develop differentiated plans for medication, monitoring, and intervention [13]. For children with allergic asthma, the plan focuses on strengthening allergen avoidance and desensitization interventions; For infection induced asthma, the plan focuses on respiratory infection prevention and mucosal immune regulation; For exercise-induced asthma, the plan focuses on optimizing exercise programs and preoperative preventive interventions; For children with comorbidities of obesity, anxiety, and allergic rhinitis, it is necessary to carry out collaborative management of comorbidities simultaneously. Hierarchical classification management breaks the traditional "one-size-fits-all" diagnosis and treatment model, achieves precise policy implementation, effectively improves long-term disease control rates, and reduces problems of overtreatment and undertreatment.

3.2. Full-cycle home dynamic monitoring and management

Long-term home monitoring is the foundation of refined management of childhood asthma, which can achieve dynamic tracking of the condition and early risk warning [14]. By relying on non-invasive devices such as PEF instruments, intelligent auscultation equipment, and portable FeNO detectors, a home monitoring system is constructed to guide parents in recording daily respiratory indicators, symptom changes, medication use, and triggering factors of their children, forming continuous disease follow-up data [15]. Medical staff interpret monitoring data in real-time through online platforms and adjust treatment plans in a timely manner. Medical staff intervene in advance for children with abnormal indicators and potential risk of acute attacks to avoid the risk of acute attacks. Compared to traditional quarterly and annual outpatient follow-up, home dynamic monitoring can capture intermittent and hidden fluctuations in medical conditions, solving the problem of one-sidedness in outpatient single evaluation. This can achieve precise, continuous, and dynamic management of asthma throughout the entire process, significantly reducing the frequency of emergency and hospitalization for pediatric patients.

3.3. Standardization of medication use and refined management of compliance

Poor medication adherence and improper inhalation procedures are the main human factors leading to poor control of childhood asthma. Refined medication management is a key link in long-term control [16]. In clinical practice, medical staff should adjust the personalized inhalation device according to the patient's age. For younger children, medical staff give priority to using a spacer device to assist inhalation. For school-

age children, medical staff will regulate the use of dry powder inhalers and correct their incorrect operating techniques one-on-one. At the same time, it is necessary to establish a hierarchical medication guidance system, adjust the dosage and frequency of medication according to the remission period, stable period, and attack period of the disease, and prevent parents from reducing, stopping, and abusing medication on their own. Relying on intelligent inhalation devices and online follow-up systems, medical staff monitor the medication duration and frequency of children in real time, automatically push medication reminders, and carry out personalized health education for children and parents with poor compliance. Multiple studies have confirmed that refined medication management can effectively improve medication adherence in children with asthma and significantly enhance long-term disease control effectiveness [17].

3.4. Multidimensional comprehensive intervention collaborative management

Fine management is not a single medication control, but a multidimensional collaborative intervention system that covers environment, exercise, nutrition, and psychology. In terms of environmental control, based on the screening results of allergens in pediatric patients, doctors develop personalized home environment optimization plans to accurately avoid triggering factors such as dust mites, pollen, and cooking fumes; In terms of exercise intervention, based on the patient's condition tolerance, doctors develop a layered aerobic exercise plan to avoid high-intensity stimulation exercise and improve cardiovascular function and reduce airway hyperresponsiveness through moderate exercise; In terms of nutritional intervention, doctors provide targeted supplementation of anti-inflammatory nutrients to children, correct malnutrition or obesity, and regulate the immune balance of the body [18]. In terms of psychological intervention, doctors alleviate the anxiety and fear emotions of children and parents, and alleviate airway spasms induced by psychological stress. Multidimensional collaborative intervention can reduce asthma triggering factors from the root, establish a long-term management model of drug + non-drug integration, and achieve comprehensive and refined control of asthma [19].

3.5. Intelligent remote follow-up management strategy

Digital intelligent follow-up is an important extension of refined management of childhood asthma in the new era, effectively solving the problems of traditional follow-up gaps and weak grassroots control [20]. Based on the asthma special management mini program, online follow-up platform, and intelligent wearable monitoring devices, medical staff have built a hospital community family three-level linkage follow-up system. Medical staff regularly push personalized health education, rehabilitation guidance, and follow-up reminders. Differentiated follow-up services are provided by medical staff for children of different ages and with different medical conditions. For children with mild stable asthma, they extend the follow-up intervals. For children with moderate-to-severe high-risk asthma, they increase the follow-up frequency. At the same time, they use artificial intelligence algorithms to analyze long-term monitoring data of pediatric patients, automatically predict the trend of disease progression, and develop intervention plans in advance. Intelligent remote follow-up breaks through the limitations of time and space, achieving normalized, precise, and long-term health management, significantly improving the standardization and accessibility of the entire diagnosis and treatment of childhood asthma.

4. Conclusion

The new non-invasive diagnostic technology, with its advantages of safety, convenience, dynamic monitoring, and adaptability to children's physiological characteristics, effectively solves the clinical pain points of difficult early screening, classification diagnosis, and dynamic evaluation of childhood asthma. At present, there are still problems in this field such as inconsistent non-invasive testing standards, insufficient popularization of grassroots technology, poor compliance with long-term family management, and incomplete individualized precision plans, which restrict the comprehensive implementation of the precision diagnosis and treatment system. In the future, it is necessary to optimize further the threshold and operating standards for children's exclusive non-invasive diagnosis, and promote the standardization of primary diagnosis and treatment equipment and technology; It is necessary to improve individualized and precise management models based on AI big data, and build a dynamic control system throughout the entire lifecycle; It is necessary to deepen the interdisciplinary and integrated management model of traditional Chinese and Western medicine, promote the development of early screening, precision, long-term, and intelligent diagnosis and treatment of childhood asthma, and comprehensively improve the standardized and precise diagnosis, treatment, and long-term management level of childhood asthma in China.

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References

[1] Dong P, Shang L, 2023, Shang Lili's Experience in Treating Childhood Bronchial Asthma Based on the "Using Communication as an Application" Method. Journal of Modern Integrated Traditional Chinese and Western Medicine, 32(2): 205–209.

[2] Shi X, Pan X, Wan Y, et al., 2019, Overview of Exhaled Breath Condensate Detection and Its Application in Respiratory Diseases. South China Journal of National Defense Medicine, 33(1): 67–71.

[3] Qu J, 2026, Analysis of the Application Value of Exhaled Nitric Oxide Testing in the Diagnosis and Treatment of Children with Cough Variant Asthma. Journal of Medical Science Yanbian University, 49(2): 41–44.

[4] Li Q, Liu J, Guo X, et al., 2026, Characteristics of Academic Ability in Children with Asthma and Its Correlation with Fractional Exhaled Nitric Oxide and Pulmonary Function. Practical Journal of Cardiac Cerebral Pneumal and Vascular Diseases, 34(7): 61–66.

[5] Deng D, Lin H, Wu Z, et al., 2025, Study on the Diagnostic Efficacy of Exhaled Nitric Oxide and Lung Function Testing Combined with Serum Immunoglobulin E for Non-Specific Respiratory Diseases in Children. Chinese Prescription Drugs, 23(3): 100–103.

[6] Tian M, 2022, Assessment and Treatment Methods for Upper and Lower Airway Inflammation. Chinese Journal of Practical Pediatrics, 37(9): 686–691.

[7] Zhu M, Zhao T, 2025, Research Progress of Artificial Intelligence in Multidimensional Precision Diagnosis and

Treatment of Bronchial Asthma. Biomedical Translational, 6(4): 36–43.

[8] Ye Q, Li D, Zheng J, 2026, Research Progress of Respiratory Acoustic Analysis in Preschool Children with Asthma. Modern Practical Medicine, 38(3): 225–228.

[9] Li X, Tang M, Ma X, et al., 2026, Analysis of Tidal Respiratory Lung Function Monitoring Results in Premature Infants with Bronchopulmonary Dysplasia. Yunnan Medicine, 47(2): 24–27.

[10] Xu L, Deng J, 2022, Research Progress on the Role of Airway Epithelial Mesenchymal Transition in Asthma Airway Remodeling. Journal of Guangxi Medical University, 1–11.

[11] Jiao S, Gu H, Wang W, et al., 2026, Value of Peripheral Blood Eosinophil Count and Fractional Exhaled Nitric Oxide in the Diagnosis and Management of Cough Variant Asthma in Children. Journal of North Sichuan Medical College, 41(6): 739–742.

[12] Zhou H, Zhang X, Qin H, et al., 2026, Metabolomics: A New Perspective for Precise Diagnosis and Treatment of Bronchial Asthma. Chinese Journal of Respiratory and Critical Care, 25(6): 439–443.

[13] Chen Z, Wu D, 2026, The Treatment Plan for Severe Asthma and the Mechanism of Decreased Glucocorticoid Responsiveness. Journal of Physiology, 1–27.

[14] Wei M, Dong X, Wang S, 2025, Research and Application of Integrated Intelligent Management Mode for Children's Asthma at Home Based on "Internet +". China Digital Medicine, 20(1): 26–31.

[15] Yue Y, Li L, Hu C, et al., 2025, The Application Value of Home Dynamic Monitoring of FeNO and PEF in the Management of Childhood Asthma. Practical Clinical Medicine, 26(6): 47–52 + 63.

[16] Li M, 2026, Study on the Effect of Standardized Nursing Intervention on Compliance and Readmission Rate of Children with Acute Asthma Attacks. Standard Living, 2026(3): 314–316.

[17] Xu J, Guo X, Dai J, et al., 2025, The Application Value of the "Comprehensive Specialized Combination" Model in the Management of Pediatric Bronchial Asthma. Jilin Medical Journal, 46(11): 2843–2847.

[18] Sheng J, Chen Y, Lin Y, et al., 2025, Research Progress on the Application of Nutritional Intervention in Children with Asthma. Zhejiang Medical Journal, 47(8): 889–893 + 896.

[19] Wu J, 2025, Application of Multi-Dimensional Collaborative Nursing and Respiratory Function Training in Children with Severe Pneumonia. Journal of Shandong Medical College, 47(2): 86–88.

[20] Lu G, Mai S, Ouyang X, et al., 2026, Research on the Application Effect of Standardized Medical Record System Combined with Internet Management Mode in the Control of Childhood Asthma. Pediatrics of Integrated Traditional Chinese and Western Medicine, 18(2): 93–97.

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Research Progress and Standardization Challenges of NMR Technology in the IVD Field

Ran Guo, Chao Xu*

Shanghai Institute of Medical Device Testing, Shanghai 201318, China

Author to whom correspondence should be addressed.

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Abstract: In Vitro Diagnostics (IVD) is central to precision medicine, enabling disease screening, diagnosis, and therapeutic monitoring. While mass spectrometry (MS) remains the dominant platform for metabolomics, Nuclear Magnetic Resonance (NMR) spectroscopy has emerged as a robust complementary technology due to its high reproducibility, quantitative reliability, and non-destructive nature. This review systematically evaluates the role of NMR-based metabolomics in clinical IVD, focusing on applications in oncology, cardiovascular disease, and neurology. This study critically examines technical strengths and limitations and identifies key barriers to clinical translation, particularly in standardization, data harmonization, and regulatory validation. Finally, we propose a framework to facilitate the integration of NMR into routine clinical workflows.

Keywords: In Vitro diagnostics; NMR spectroscopy; Metabolomics; Clinical standardization; Biomarkers

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1. Introduction

The global healthcare landscape is undergoing a paradigm shift toward precision medicine, which emphasizes individualized diagnosis and treatment based on patient-specific biological characteristics. In this context, in vitro diagnostics (IVD) serves as a cornerstone technology, enabling clinicians to access critical biochemical information from patient-derived samples such as blood, urine, and cerebrospinal fluid. Traditional IVD techniques, including immunoassays and molecular diagnostics, typically focus on a limited number of biomarkers. However, complex diseases such as cancer, cardiovascular disorders, and neurodegenerative conditions involve multifactorial biochemical alterations that cannot be fully captured by single-analyte measurements [1,2].

Metabolomics, defined as the comprehensive analysis of small-molecule metabolites within biological systems, has emerged as a powerful approach for capturing the downstream effects of gene expression and environmental interactions. Among the analytical platforms used in metabolomics, nuclear magnetic

resonance (NMR) spectroscopy occupies a unique position due to its inherent reproducibility, minimal sample preparation requirements, and quantitative robustness.

Despite these advantages, NMR has not yet achieved widespread adoption in clinical IVD settings, where mass spectrometry (MS) remains the dominant technology due to its superior sensitivity and broader metabolite coverage. Nevertheless, the strengths of NMR make it particularly suitable for standardized, high-throughput clinical workflows, especially in applications requiring high reproducibility and longitudinal monitoring [1,3].

This review aims to systematically evaluate the current status of NMR-based metabolomics in IVD, analyze its clinical applications, and identify the key challenges that must be addressed to enable its translation into routine clinical practice.

2. Technical characteristics of NMR in clinical settings

2.1. Fundamental principles

NMR spectroscopy is based on the interaction between nuclear spins and an external magnetic field. When placed in a magnetic field, certain atomic nuclei (such as ^{1}H, ^{13}C, and ^{31}P) absorb and re-emit electromagnetic radiation at characteristic frequencies. These frequencies, known as chemical shifts, provide detailed information about molecular structure and environment.

In metabolomics applications, proton (^{1}H) NMR is the most commonly used modality due to its high sensitivity and abundance in biological samples. The resulting spectra consist of peaks corresponding to different metabolites, enabling both qualitative identification and quantitative analysis.

2.2. Analytical advantages

NMR offers several key advantages that make it attractive for clinical applications. The signal intensity in NMR is directly proportional to the molar concentration of the analyte, allowing for absolute or near-absolute quantification without extensive calibration[4]. NMR measurements are highly reproducible across different instruments and laboratories when standardized protocols are followed. Samples remain intact after analysis, enabling repeat measurements or complementary analyses. Compared to MS, NMR requires relatively simple and standardized sample preparation procedures. NMR provides detailed structural insights, facilitating metabolite identification.

2.3. Limitations

Despite its strengths, NMR has several inherent limitations. NMR typically detects metabolites in the micromolar range, which is significantly less sensitive than MS-based techniques. Overlapping peaks in complex biological samples can complicate data interpretation. NMR detects fewer metabolites compared to MS. The acquisition and maintenance of high-field NMR instruments require substantial investment.

3. NMR-based metabolomics workflow in IVD

The application of NMR in IVD involves several key steps, as shown in **Figure 1**.

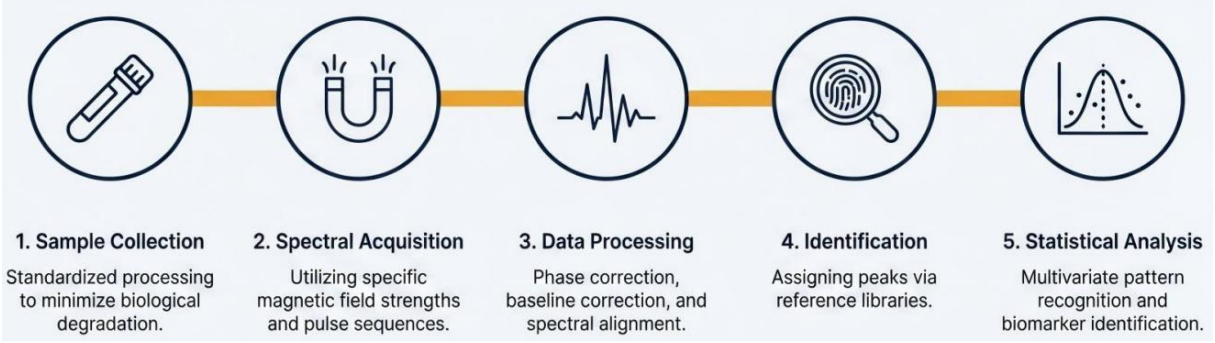


Figure 1. NMR-based metabolomics Workflow in IVD.

(1) Sample collection and preparation
Biological samples are collected and processed under standardized conditions to minimize variability.
(2) Spectral acquisition
NMR spectra are acquired using standardized pulse sequences.
(3) Data processing
Spectral data are processed through phase correction, baseline correction, and alignment.
(4) Metabolite identification and quantification
Peaks are assigned to specific metabolites using reference libraries.
(5) Statistical analysis
Multivariate statistical methods are used to identify patterns and biomarkers.

4. Clinical applications

4.1. Oncology

NMR-based metabolomics has been used to identify metabolic alterations associated with tumorigenesis. Studies have demonstrated its utility in detecting metabolic signatures related to cancer progression, including altered glycolysis and lipid metabolism[5].

Diagnostic models based on NMR-derived metabolite panels have achieved promising performance (AUC > 0.80) in research settings, though large-scale validation remains necessary.

4.2. Cardiovascular disease

NMR enables detailed lipoprotein subclass analysis, providing improved cardiovascular risk stratification beyond conventional lipid measurements. Clinical studies have shown associations between NMR-derived lipoprotein profiles and cardiovascular events[6].

4.3. Neurological disorders

NMR analysis of CSF and plasma has revealed metabolic alterations associated with neurodegenerative diseases. Changes in energy metabolism and neurotransmitter-related metabolites have been reported in conditions such as Alzheimer's disease and multiple sclerosis.

5. Standardization challenges

Despite the analytical strengths of NMR, its translation into routine IVD practice is critically constrained by multi-level standardization challenges that span the entire analytical pipeline.

5.1. Pre-analytical variability

Pre-analytical factors represent one of the largest sources of variability in metabolomics. Variations in patient preparation (fasting vs non-fasting), sample collection tubes (e.g., EDTA vs heparin), processing time, storage temperature, and freeze–thaw cycles can significantly alter metabolite concentrations. Even minor deviations can introduce systematic bias, undermining cross-study comparability. Therefore, strict standard operating procedures (SOPs) and biobanking protocols are essential for clinical-grade reproducibility.

5.2. Analytical and instrumental variability

Although NMR is inherently reproducible, differences in magnetic field strength (e.g., 400 MHz vs 600 MHz), probe design, pulse sequences, and shimming quality can still affect spectral resolution and peak positions. Inter-vendor variability further complicates harmonization. The implementation of standardized acquisition protocols, internal calibration compounds (e.g., TSP), and routine quality control (QC) procedures is necessary to ensure data consistency across laboratories.

5.3. Data processing and quantification

Post-acquisition data processing remains insufficiently standardized. Variations in phase correction, baseline correction, spectral alignment, and binning strategies can lead to inconsistent results. Furthermore, metabolite identification relies on spectral libraries that may differ between platforms. The lack of universally accepted reference databases and validated quantification pipelines limits reproducibility and regulatory acceptance.

5.4. Biological and population variability

Metabolomic profiles are influenced by age, sex, diet, microbiome composition, medication, and circadian rhythms. Without appropriate normalization and large reference cohorts, distinguishing disease-specific signals from physiological variation remains challenging. This highlights the need for population-scale datasets and stratified reference intervals.

5.5. Regulatory and clinical validation barriers

For NMR-based assays to qualify as IVD tests, they must meet stringent regulatory requirements, including analytical validity, clinical validity, and clinical utility. Current evidence is largely derived from small or single-center studies, which limits generalizability. Regulatory frameworks such as ISO 15189, FDA approval pathways, and EU IVDR (2017/746) require robust multi-center validation, traceability, and standardized reporting formats, areas where NMR metabolomics is still evolving [7].

6. Future perspectives

To enable the routine clinical adoption of NMR-based metabolomics in IVD, several strategic advancements are required.

6.1. Development of global standardization frameworks

International collaboration is needed to establish consensus guidelines for sample handling, spectral acquisition, and data processing. Initiatives toward harmonized SOPs and inter-laboratory ring trials will be critical for ensuring reproducibility and comparability across institutions.

6.2. Integration with artificial intelligence and automation

Advances in machine learning and artificial intelligence offer opportunities to automate spectral deconvolution, metabolite identification, and biomarker discovery. AI-driven pipelines can reduce operator-dependent variability and improve scalability, particularly in high-throughput clinical environments.

6.3. Multi-omics and multi-modal integration

Future diagnostic strategies will likely rely on integrating NMR metabolomics with complementary technologies such as LC-MS, genomics, and proteomics. Such multi-omics approaches can provide a more comprehensive understanding of disease mechanisms and improve diagnostic accuracy.

6.4. Expansion of clinical evidence base

Large-scale, multi-center, longitudinal studies are essential to validate NMR-derived biomarkers and establish clinical utility. Prospective trials linking metabolomic profiles to clinical outcomes will be particularly important for regulatory approval and clinical adoption.

6.5. Translation into clinical decision support systems

To be clinically useful, NMR-derived data must be integrated into actionable decision-making frameworks. This includes the development of standardized reporting formats, reference ranges, and risk models that can be readily interpreted by clinicians.

6.6. Cost reduction and technological innovation

Emerging developments in benchtop and low-field NMR systems may reduce costs and improve accessibility. While these systems currently have lower resolution, ongoing improvements may enable their use in targeted clinical applications, particularly in decentralized or resource-limited settings.

7. Conclusion

NMR-based metabolomics offers a reproducible and quantitative platform for clinical diagnostics, with growing applications in multiple disease domains. However, its transition into routine IVD practice is constrained by technical and regulatory challenges. Addressing standardization and validation issues will be essential for broader clinical adoption.

Disclosure statement

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References

[1] Nicholson J, Holmes E, Kinross J, et al., 2012, Metabolic Phenotyping in Clinical and Surgical Environments, Nature, 491(7424): 384-392.

[2] Dona A, Jiménez B, Schäfer H, et al., 2014, Precision High-Throughput Proton NMR Spectroscopy of Human Urine, Serum, and Plasma for Large-Scale Metabolic Phenotyping, Analytical Chemistry, 86(19): 9887-9894.

[3] Emwas A, Roy R, McKay R, et al., 2019, NMR Spectroscopy for Metabolomics Research, Metabolites, 9 (7): 123.

[4] Wishart, D, 2008, Quantitative Metabolomics Using NMR, TrAC Trends in Analytical Chemistry, 27(3): 228-237.

[5] Gowda N, Raftery D, 2019, NMR-Based Metabolomics, Humana.

[6] Otvos J, Mora S, Shalaurova I, et al., 2011, Clinical Implications of Discordance Between Low-density Lipoprotein Cholesterol and Particle Number, Journal of Clinical Lipidology, 5(2): 105-113.

[7] European Parliament and Council of the European Union, 2017, Regulation (EU) 2017/746 of the European Parliament and of the Council of 5 April 2017 on in vitro diagnostic medical devices and repealing Directive 98/79/EC and Commission Decision 2010/227/EU, 117: 176-332.

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Review of Research Progress and Clinical Application of Non-pharmacological Intervention in Children with Bronchial Asthma

Jijing Han,Ying Guo*

Department of Hepatobiliary Surgery, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

Author to whom correspondence should be addressed.

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Abstract: Childhood bronchial asthma is a common chronic airway inflammatory disease in pediatrics. Long-term use of inhaled steroids alone has practical problems such as insufficient compliance, parents' concerns about adverse hormone reactions, and inadequate seizure control. Non-pharmacological intervention, as a synergistic means of drug therapy, can reduce airway hyperresponsiveness, decrease the frequency of acute attacks, and improve lung function and quality of life in children from multiple perspectives, including environmental control, respiratory rehabilitation, exercise regulation, psychological counseling, nutritional microecology, traditional Chinese medicine external treatment, and digital health management. This article provides a comprehensive review of the mechanisms of action, latest research evidence, and stratified clinical application scenarios of various non-pharmacological interventions. This article looks forward to the development direction of precision, family-oriented, and integrated intervention of traditional Chinese and Western medicine, providing evidence-based reference for the standardized comprehensive management of pediatric asthma.

Keywords: Childhood bronchial asthma; Non-pharmacological intervention; Respiratory training; Airway management; Collaboration between Traditional Chinese Medicine and Western Medicine

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1. Introduction

The main characteristics of bronchial asthma include chronic airway inflammation, airway hyperresponsiveness, reversible airflow limitation, and airway remodeling [1]. Its clinical manifestations mainly include recurrent wheezing, shortness of breath, and possible accompanying symptoms such as chest tightness or cough. The cumulative prevalence of asthma among children aged 0–14 in China has reached 3.02%, with moderate to severe cases experiencing 4–7 acute attacks per year, severely affecting growth and development, campus activities, and the burden of family care [2]. At present, the global guidelines for

the prevention and treatment of childhood asthma all consider inhaled corticosteroids as the first-line long-term control plan, but the control rate of standardized medication in China is insufficient. The main obstacles include multiple factors such as children's resistance to inhalation devices, parents' excessive concern about hormone suppression height, repeated aggravation induced by comorbidities such as anxiety and obesity, and continuous exposure to environmental allergens. Single-drug treatment is difficult to cover the entire chain of risk factors for asthma. Non-pharmacological interventions, with their advantages of non-invasiveness, safety, and long-term implementation at home, have gradually become the fundamental module of comprehensive management systems. In recent years, multiple network meta-analyses have confirmed that the combination of environmental control, respiratory muscle training, personalized aerobic exercise, acupoint therapy, psychological intervention, and medication can reduce the number of acute attacks, while simultaneously increasing the forced expiratory volume in one second (FEV_1), peak expiratory flow rate (PEF), and the Children's Asthma Quality of Life Questionnaire (PAQLQ) score [3–5]. At present, the evidence levels of various intervention methods are uneven, and there is a lack of standardized implementation pathways at the grassroots clinical level. This paper systematically summarizes various non-drug intervention mechanisms and clinical adaptation populations, and provides evidence-based support for the clinical construction of drug-non-drug integrated long-term management programs.

2. Environmental source prevention and control interventions

2.1. Precise control of indoor allergens

Dust mites, pet dander, and mold are the main inhaled triggers of asthma in preschool children. This type of intervention is a universal basic intervention for all children with asthma, which runs through the entire course of the disease [6]. The existing unified evidence-based plan includes a complete set of mite resistant bedding covering, stable indoor humidity maintenance of 40% to 60%, regular high-temperature cleaning of fabrics, reduction of carpet, fabric and soft furnishings, and prohibition of indoor breeding of furry pets such as cats and dogs [7]; Wet kitchens and bathrooms are equipped with dehumidification devices to prevent mold growth; In autumn and winter, air purifiers that meet national standards are activated to filter PM2.5 and pollen particles continuously. Wu Qingcui's research shows that standardized implementation of home allergen control can effectively improve the lung function of children, reduce the probability of disease occurrence, and improve the treatment effect of asthma in children through self-management [8]. For children with aggravated pollen season, wearing a closed mask when going out and changing their outer clothing and cleaning their nasal cavity when returning home can significantly reduce the burden of airway allergens.

2.2. Air pollution and avoidance of irritants

Tobacco smoke, kitchen fumes, and volatile organic compounds (formaldehyde, benzene) from decoration can directly damage the airway epithelial barrier, amplifying inflammation and airway hyperresponsiveness [9]. Clinical management requires families of children with asthma to prohibit smoking completely, use strong smoke exhaust equipment throughout cooking, and allow newly renovated houses to ventilate and sit for at least 6 months before long-term residence [10]. During periods of heavy outdoor pollution, children with asthma should reduce prolonged outdoor activities. School-aged children should prioritize conducting physical education classes during periods of good air quality. In view of the high incidence of coal-fired heating and haze in the northern winter, the community combined with pediatrics to carry out family

environment screening intervention, and follow-up confirmed that continuous avoidance of stimulants can reduce the annual emergency visit rate.

2.3. Pre-protection against respiratory infections

Viral infection is the primary cause of acute asthma attacks in children, accounting for over 65% of the triggering factors [11]. Basic intervention measures include timely completion of influenza and pneumococcal vaccination; Wearing masks in crowded places during seasonal changes and developing standardized hand washing habits; and isolating family members with colds to avoid cross-infection. Microecological and nutritional interventions can be used as auxiliary means to enhance respiratory mucosal resistance and reduce asthma exacerbations induced by infections.

3. Respiratory rehabilitation and exercise intervention

3.1. Graded respiratory muscle training

Respiratory training adjusts respiratory rhythm, strengthens diaphragm and intercostal muscle strength, corrects shallow and rapid chest breathing commonly found in children with asthma, reduces end-expiratory airway depression, and alleviates symptoms of wheezing and chest tightness. It is suitable for children over 4 years old who can cooperate with instructions [12]. The mainstream training programs are divided into three categories: abdominal deep breathing, pursed lip breathing, and inspiratory muscle resistance training. Young children use gamified abdominal breathing techniques (such as blowing bubbles or balloons) to enhance their coordination; Children over 8 years old can use a portable inspiratory muscle training instrument, training 10–15 minutes a day for 8 weeks as a complete course of treatment. Research by Ye Fang shows that respiratory training can effectively improve lung function in children with asthma, increasing forced vital capacity (FVC), maximum expiratory volume in the first second (FEV1%), and peak expiratory flow rate (PEF) [13]. This intervention has no adverse reactions and can be implemented daily at home, making it the most valuable rehabilitation method for grassroots promotion.

3.2. Individualized aerobic exercise program

There is a cognitive misconception in previous clinical practice that “children with asthma should not exercise”. The existing guidelines clearly state that moderate-intensity exercise can improve cardiopulmonary reserve, reduce airway inflammation, and alleviate exercise-induced wheezing. Its core lies in layered adaptation of exercise types and durations. Children with mild control can engage in aerobic exercises such as jogging, swimming, cycling, etc. 3–5 times a week for 20–30 minutes each time; Children with moderate to severe uncontrolled conditions should avoid vigorous exercise in cold air or pollen environments. 10 minutes before exercise, they should inhale short-acting vasodilators preventively and gradually increase the intensity of exercise. Swimming is the preferred exercise for children with asthma because warm and humid air reduces airway irritation. Chen Qiong et al. confirmed in their 3-month exercise intervention cohort study that under appropriate management and monitoring, moderate-intensity aerobic exercise has good safety and effectiveness, and can improve the exercise ability and quality of life of children with asthma [14].

4. Psychological intervention and mind-body coordination therapy

4.1. Anxiety counseling for children and parents

Chronic recurrent asthma attacks can easily cause fear, inferiority, and separation anxiety in children. During long-term parental care, the child develops persistent anxiety and depression. Negative emotions increase vagal tone through the neural-airway reflex pathway, inducing bronchial smooth muscle spasms and forming a vicious cycle of "emotion-wheezing". Clinical interventions include cognitive-behavioral therapy (CBT), parent-child synchronous psychological counseling, and game guidance. This study conducted emotion recognition training for children aged 6 and above, guiding parents to avoid overprotection and exaggerating disease risks, which can cause psychological burden on the children [15].

4.2. Music-assisted respiratory therapy

Music therapy belongs to low-threshold physical and mental interventions. It relies on soothing music combined with rhythmic breathing to synchronously regulate the autonomic nervous system, calm anxiety, and regulate breathing patterns [16]. Young children receive a combination of nursery rhymes, musical instrument playing, and abdominal breathing training; school-aged children listen to soothing instrumental music for 15 minutes daily. Comparative experiments have confirmed that the music exhalation method can significantly improve the PAQLQ quality of life score of pediatric patients and reduce the frequency of waking up and wheezing at night. It is suitable for outpatient assistance and daily family relaxation intervention [17].

5. Nutritional regulation and intestinal microbiota intervention

5.1. Individualized regulation of dietary structure

The core of dietary intervention is divided into two parts: avoiding allergenic foods and supplementing anti-inflammatory nutrients. This requires precise avoidance of allergenic ingredients through skin pricking and serum-specific IgG screening. In daily life, children should reduce their intake of high-sugar, fried, and artificially added foods; Increase intake of deep-sea fish, flaxseed, Omega-3 unsaturated fatty acids, fresh fruits and vegetables, and vitamins; and inhibit chronic airway inflammation. For children with low serum levels of 25-hydroxyvitamin D, we should add egg yolks and deep-sea fish to their diet, and if necessary, supplement vitamin D in a standardized manner. Several reviews have confirmed that only the vitamin D deficiency subgroup can significantly reduce the risk of asthma exacerbation. Obese children with asthma should strictly control their total calories, and weight loss interventions can significantly improve symptoms of airflow limitation and wheezing.

5.2. Probiotics and immunomodulators

The theory of the gut-airway axis promotes the rapid development of microecological intervention. During the neonatal period, exclusive breastfeeding for ≥ 6 months can shape a stable gut microbiota and reduce the risk of childhood asthma in the long term [18]. For children diagnosed with asthma, targeted supplementation of specific strains of probiotics and bacterial lysates can regulate Th1/Th2 immune imbalance and reduce the risk of recurrent respiratory infections leading to acute asthma attacks.

6. Traditional Chinese medicine characteristics of external treatment of non-drug intervention

6.1. Acupoint application and moxibustion therapy

Based on the theory of "treating winter diseases in summer and eliminating latent phlegm as the chronic root cause", the application of Sanfu/Sanjiu acupoint plaster is the most widely used traditional Chinese medicine external treatment method in pediatrics in China. It selects acupoints such as Feishu, Danzhong, Dingchuan, and other acupoints to warm yang and dissolve phlegm, regulate the lungs and spleen. It is suitable for children with cold asthma and repeated winter exacerbations. Standardized application for three consecutive years is a complete conditioning cycle, which can reduce wheezing attacks in autumn and winter seasons. Mild suspended moxibustion and indirect moxibustion can also reduce airway hyperresponsiveness, but young children need to control the temperature to avoid burns strictly. Warm moxibustion interventions are not suitable for treating febrile asthma (yellow phlegm, sore throat). Zhang Jianxiu pointed out in his research that the use of traditional Chinese medicine acupoint application for winter and summer treatment of childhood asthma has a more significant therapeutic effect and can improve lung function in children [19]. It can improve the lung function of children, improve the level of inflammatory factors, promote the disappearance of various symptoms, help to control the disease, and promote the early recovery of children.

6.2. Pediatric Tuina conditioning

Tuina stimulates meridians and acupoints to regulate the internal organs and qi, and eliminate phlegm. Regarding this, infants and young children aged 0–6 have a high degree of cooperation. It does not cause trauma and is easy for parents to study at home. During the relief period, the main method is to strengthen the spleen and supplement the lungs. During the attack period, it is supplemented by anti-asthmatic and soothing operations. The therapy is performed 3 to 5 times per week. Continuous intervention for 3 months can reduce nighttime coughing and wheezing, improve appetite and physical fitness. A summary analysis of over 1656 pediatric patients confirmed that pediatric massage therapy has significant therapeutic effects on chronic remission of asthma. It can not only improve lung function of children, but also effectively prevent asthma attacks [20].

7. Digital health management intervention

7.1. Home monitoring and online health education

The intelligent peak flow velocity meter, asthma management mini program, and short video science popularization platform constitute a digital intervention system. The child should keep a daily record of PEF values and a wheezing diary at home. The child has regular online follow-up visits, and medical staff remotely push age-specific medication, respiratory training, and environmental control science popularization content. Compared with traditional outpatient follow-up, digital management can improve medication compliance by 37%, significantly enhance parents' disease awareness, and provide continuous standardized guidance for children in remote areas at the grassroots level.

7.2. Real-time monitoring of smart wearables

The new wearable device can synchronously monitor respiratory rate, heart rate, and nighttime blood oxygen saturation, warn of the risk of early wheezing attacks, and timely push intervention reminders. It is currently

used in high-risk children with moderate to severe and frequent nighttime attacks. However, due to high equipment costs, there are limitations to grassroots popularization. Lightweight and low-cost monitoring equipment is the development direction for the future.

8. Conclusion

Non-pharmacological intervention for childhood bronchial asthma is not a drug replacement plan, but a basic collaborative management measure that runs through the entire cycle of acute, remission, and stable phases. At present, there are still shortcomings in this field, such as incomplete individualized stratification schemes, insufficient grassroots promotion support, and weak evidence-based interventions. Future research can focus on three directions: One is to conduct large sample, long-term stratified RCTs, clarify the optimal combination intervention mode for children of different ages, allergy types, and severity, as well as construct a standardized clinical pathway; The second is to promote the integration of traditional Chinese and Western medicine, unify the operation norms of syndrome differentiation, establish a community family linkage home intervention guidance system, and reduce the long-term implementation threshold; The third is to rely on artificial intelligence and intelligent wearable devices to create a full cycle digital precision management platform, realizing the integration of risk warning and remote rehabilitation guidance. Clinical physicians need to shift their single medication mindset and incorporate non-pharmacological interventions into the routine content of initial diagnosis evaluation and long-term follow-up. They need to simultaneously carry out systematic health education for parents, promote the deep integration of drug and non-drug interventions, build a safe, long-term, and accessible comprehensive prevention and treatment system for childhood asthma, and continuously improve the overall control level of childhood asthma in China.

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References

[1] Wang H, Zhou L, Wang Y, et al., 2026, Research Progress on Traditional Chinese Medicine Treatment of Asthma Based on cAMP/PKA Signaling Pathway. Asia Pacific Traditional Medicine, 22(1): 225–231.

[2] Wang Y, Zhou Y, Zhang Y, et al., 2020, Prevention and Treatment Plan for Children with Bronchial Asthma Complicated with SARS-CoV-2 Infection. Journal of Clinical Pediatrics, 38(3): 233–235.

[3] Feng F, Zhang Y, Qin F, 2026, The Intervention Effect of Wuqinxi on the Physiological Function and Quality of Life of Children with Asthma. Journal of Physical Education, 33(3): 149–156.

[4] Ma D, Wang Z, Wang Y, 2026, Progress in the Application of Traditional Chinese Medicine External Treatment Methods in the Treatment of Cough Variant Asthma in Children. Chinese Journal of Prescription Drugs, 24(5): 105–110.

[5] Ye B, Luo A, 2026, Application of Traditional Chinese Medicine Non-Pharmacological Therapy Based on Traditional Chinese Medicine Theory in Modern Acute Disease Management. Journal of Traditional Chinese Medicine Management, 34(3): 163–165.

[6] Wang X, Cheng M, 2026, Pet-Derived Respiratory Diseases. Journal of Southeast University (Medical Edition), 45(1): 6–10.

[7] Liu J, 2025, Don't Be Anxious if You Have an "Asthma" Child at Home: A Comprehensive Guide to the Prevention and Treatment of Childhood Asthma. Famous Doctor, 2025(14): 2–3.

[8] Wu Q, 2020, Application Analysis of Home-Based Self-Care Behavior Intervention Model in Asthma Management of School-Age Children. Maternal and Child World, 2020(9): 178.

[9] Jin L, Lin J, Sun H, et al., 2026, Research Progress on Influencing Factors of Childhood Asthma Control. Chinese Journal of Integrated Traditional Chinese and Western Medicine Pediatrics, 18(2): 104–110.

[10] Cui W, Ming X, Kang J, et al., 2025, Application of Standardized Health Education Combined with Continuity of Care in the Treatment of Pediatric Bronchial Asthma. Clinical Research, 33(8): 146–149.

[11] Zhang L, Su M, Li C, et al., 2017, Clinical Characteristics of Acute Exacerbation of Bronchial Asthma in Children and Analysis of Age-Related Differences. Journal of Medical Research, 46(8): 91–95.

[12] Li J, Lu X, 2026, The Application Effect of Fun Respiratory Function Training Combined with Airway Specialized Nursing in Children with Bronchial Asthma. Frontiers of Medicine, 16(18): 123–126.

[13] Ye F, 2017, The Effect of Respiratory Training on Pulmonary Ventilation Function in Children with Asthma. Contemporary Nurses (Next Issue), 2017(3): 88–89.

[14] Chen Q, Wang F, Sun X, 2020, Experimental Study on Aerobic Exercise Improving Exercise Ability and Quality of Life in Children with Asthma. Journal of Guangzhou Sport University, 40(5): 125–128.

[15] Cao X, Zhao Y, Zhang Q, et al., 2026, The Impact of Interesting Breathing Training with Multimedia Picture Stories on the Emotional State and Rehabilitation of Children with Bronchial Asthma. Chinese Journal of Health Psychology, 34(5): 695–699.

[16] Zong X, 2019, Observation of the Application Effect of Comprehensive Nursing Intervention in the Nursing of Children with Bronchial Asthma. Chinese and Foreign Women's Health Research, 2019(13): 180 + 189.

[17] Fukuda Y, 2010, Application of Music Breath Therapy in Asthma Treatment (Bronchial Asthma Music Therapy). Proceedings of the 29th World Music Education Conference: 62.

[18] Li C, Wu S, Ding H, 2026, The Relationship Between Asthma and Gut Microbiota in Special Children. Journal of Clinical Pulmonary Medicine, 2026(7): 1091–1094.

[19] Zhang J, 2023, Observation on the Therapeutic Effect of Traditional Chinese Medicine Acupoint Application Method as an Auxiliary Treatment for Childhood Asthma in Winter and Summer. Journal of Traditional Chinese Medicine External Treatment, 32(1): 77–79.

[20] Yue Q, Wang X, Ren S, et al., 2019, Systematic Review and Meta-Analysis of Randomized Controlled Trials on Pediatric Tuina Therapy for Chronic Persistent Asthma in Children. Journal of Hainan Medical College, 25(16): 1260–1266.

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Effect of Meridian-unblocking Herbal Friction Combined with Infrared Irradiation in Nursing Care for Elderly Patients with Knee Osteoarthritis

Ying Fan, Yuemin Zhang*, Jing Xu

Gongli Hospital of Shanghai Pudong New Area, Shanghai 200135, China

Author to whom correspondence should be addressed.

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Abstract: *Objective*: To explore the clinical effect of nursing intervention combining meridian-unblocking herbal friction with infrared irradiation on elderly patients with knee osteoarthritis (KOA). *Methods*: A total of 40 elderly patients with KOA admitted to our hospital from January 2024 to February 2025 were selected and divided into the conventional group and the herbal friction group by random number table, with 20 cases in each group. The conventional group received routine nursing plus infrared irradiation. On the basis of conventional nursing, the herbal friction group was given additional meridian-unblocking herbal friction. After one month of intervention, the clinical efficacy, Numerical Rating Scale (NRS) score for pain, swelling degree, Western Ontario and McMaster Universities Arthritis Index (WOMAC) for knee joint function, and the 36-Item Short Form Health Survey (SF-36) score for quality of life were compared between the two groups. *Results*: After one month of intervention, the total effective rate of the herbal friction group was significantly higher than that of the 65.00% of the conventional group ($P < 0.05$). The NRS score and swelling degree of the herbal friction group were lower than those of the conventional group ($P < 0.05$) . Meanwhile, the WOMAC score of the herbal friction group was lower, while the scores of physiological function , emotional function, and social function in the SF-36 scale were higher than those of the conventional group ($P < 0.05$). *Conclusion*: The combined nursing intervention of meridian-unblocking herbal friction and infrared irradiation can improve the clinical efficacy for elderly KOA patients. It can effectively relieve knee joint pain and swelling, reduce limitations on daily activities, improve knee joint function, and enhance patients' quality of life.

Keywords: Knee osteoarthritis; Herbal friction; Infrared irradiation

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1. Introduction

Degenerative changes of knee articular cartilage and secondary osseous lesions mainly characterize knee osteoarthritis (KOA). It has a high prevalence among the elderly population, with recurrent episodes and

protracted courses, and leads to a high disability rate, which seriously impairs the physical and mental health of patients [1,2]. The onset of KOA is closely associated with heredity, age, occupation, and metabolic disorders. With the accelerating aging process in China in recent years, the incidence of elderly KOA has increased year by year. Relevant studies predict that KOA will become one of the major disabling diseases by 2030 [3,4]. After conventional Western medicine treatment, many elderly KOA patients still suffer from unsatisfactory relief of knee pain and stiffness, and the condition is prone to recurrence [5]. From the perspective of traditional Chinese medicine (TCM), invasion of wind, cold, and damp pathogens will obstruct blood circulation and trigger inflammatory reactions of joints. Therefore, the core principles of treatment and nursing should be dispelling cold, expelling wind, activating blood circulation, and resolving stasis [6]. Infrared irradiation generates thermal effects on the affected area, accelerates lymph circulation and blood flow, promotes the absorption of inflammatory exudates and metabolites, and relieves muscle spasm so as to eliminate swelling and pain [7,8]. Herbal friction is a typical external TCM therapy. Applying meridian-unblocking herbal medicines directly on the affected knee can alleviate swelling and pain, and accelerate the recovery of knee joint function [9]. However, there is no unified clinical conclusion on whether the combined application of herbal friction and infrared irradiation can further improve the curative effect and promote the recovery of knee joints in KOA patients. Relevant research is still needed for verification. Given the above background, this study explores the application effect of meridian-unblocking herbal friction combined with infrared irradiation in nursing elderly KOA patients.

2. Materials and methods

2.1. General data

A total of 40 patients diagnosed with KOA admitted to our hospital from January 2024 to February 2025 were enrolled.

2.1.1. Inclusion criteria

(1) All patients met the diagnostic criteria for knee osteoarthritis [10,11];
(2) Aged 60 years old or above;
(3) Received no relevant treatment for arthritis within 4 weeks before enrollment;
(4) Normal cognitive and communication abilities, and agreed to the treatment and nursing regimens in this study.

2.1.2. Exclusion criteria

(1) Dysfunction of vital organs;
(2) Coagulopathy;
(3) Skin damage or infection on the affected knee joint;
(4) Knee arthritis is caused by tumors, tuberculosis, and other diseases.

The subjects were divided into the conventional group and the herbal friction group via a random number table, with 20 cases in each group. The general data of the two groups were balanced and comparable ($P > 0.05$), with no statistically significant differences in gender, age, and disease course.

2.2. Intervention methods

2.2.1. Conventional group

Routine nursing combined with infrared irradiation was implemented.

(1) Health education

Registered nurses adopted semi-structured interviews to learn about patients' physical conditions, mental status, disease cognition, and living habits according to disease severity. Brochures, PPTs, and videos were used to deliver knowledge about KOA, explain the importance of self-management, and help patients maintain a positive attitude and improve treatment compliance.

(2) Psychological counseling

Nurses communicated with patients to understand their mental state. Patients often suffered from anxiety and unease due to persistent pain and worries about treatment outcomes, which would affect therapeutic effects. Nurses relieved negative emotions and guided patients to adjust their mentality.

(3) Functional training

Patients were instructed to perform knee exercises such as sitting leg raises and supine cycling movements. The duration, intensity, and frequency of training were adjusted according to patients' tolerance to avoid overexertion and aggravation of the condition.

(4) Infrared irradiation

The YSHD-II infrared therapeutic apparatus (manufactured by Shanghai Yuejin Medical Optical Instrument Factory) was adopted. Patients took a sitting position. The therapeutic apparatus was placed 30–70 cm above the affected knee. The irradiation temperature was set at 45–55 ℃, with 15 minutes per session and once a day.

2.2.2. Herbal friction group

On the basis of all routine nursing measures, additional meridian-unblocking herbal friction was applied.

Meridian-unblocking Prescription: *Arnebia euchroma* 15 g, *Radix Paeoniae Alba* 15 g, *Radix Paeoniae* Rubra 9 g, Licorice 9 g, *Salvia miltiorrhiza* 15 g, Dandelion 15 g, *Angelica Dahurica* 6 g, Talc 10 g.

One dose of the above herbs was soaked in cold water for 30 minutes, then heated and boiled for another 30 minutes. After the medicinal liquid cooled down to 40–45 ℃, gauze soaked with the liquid was applied to the affected area. Each session lasted 15 minutes, once a day. Herbal friction and infrared irradiation were performed simultaneously.

Both groups received continuous intervention for one month before outcome evaluation.

2.3. Observation indicators

2.3.1. Clinical efficacy

(1) Markedly effective

Knee swelling and pain disappeared or were greatly relieved, and daily activities of the knee were completely unrestricted.

(2) Effective

Knee swelling and pain were partially alleviated, and the mild limitation of knee activities was improved compared with baseline.

(3) Ineffective

No improvement was observed in knee swelling, pain, and activity limitations.

Total effective rate = Markedly effective rate + Effective rate.

2.3.2. Pain and swelling degree

The Numerical Rating Scale (NRS) was used to assess pain before and after intervention. The NRS score ranged from 0 to 10 points: 0 = no pain; 1–3 = mild pain (no impact on sleep); 4–6 = moderate pain (slight impact on sleep); 7–10 = severe pain (severe disturbance to sleep). For swelling assessment, a tape measure was used to detect the circumference of the knee at about 2 cm above the patella to evaluate the swelling degree.

2.3.3. Knee joint function

The Western Ontario and McMaster Universities Arthritis Index (WOMAC) was adopted to evaluate joint symptoms and functions before and after intervention. The scale consisted of three dimensions: stiffness (2 items, 0–8 points), pain (5 items, 0–20 points), and daily activities (17 items, 0–68). Each item was scored by a 5-point scale: 0 = no symptoms, 1 = mild, 2 = moderate, 3 = severe, 4 = extremely severe. The total score ranged from 0 to 96. Higher scores indicated more severe symptoms and poorer joint function.

2.3.4. Quality of life

The 36-Item Short Form Health Survey (SF-36) was used, including physiological function, emotional function, and social function. Each dimension was scored from 0 to 100, and higher scores represented a better quality of life.

2.4. Statistical methods

SPSS 25.0 statistical software was used for data analysis. Measurement data were expressed as mean ± standard deviation ($\bar{x}$ ±s) and analyzed by *t*-test. Enumeration data were presented as cases and percentages and analyzed by the chi-square test. A *p* value less than 0.05 was considered statistically significant.

3. Results

3.1 Clinical efficacy

After one month of intervention, the total effective rate of the herbal friction group was 95.00%, which was higher than 65.00% of the conventional group ($P < 0.05$). In the herbal friction group: 12 markedly effective cases, 7 effective cases, 1 ineffective case. In the conventional group: 4 markedly effective cases, 9 effective cases, 7 ineffective cases.

3.2. Comparison of pain and swelling degree

After intervention, the NRS scores and swelling degree of both groups decreased, and the reduction range of the herbal friction group was larger than that of the conventional group ($P < 0.05$). See **Table 1**.

Table 1. Comparison of NRS scores and swelling degree ($\overline{x} \pm s$)

Group	Cases	NRS score		Knee circumference	
		Before	After	Before	After
Herbal friction group	20	6.4±1.16	2.24±0.64*	40.8±2.38	37.76±2.14*
Conventional group	20	6.39±1.08	3.18±0.71*	41.25±2.27	35.42±2.06*
t value	-	0.172	4.429	0.530	3.523
P value	-	0.865	< 0.001	0.599	0.001

Note: vs. pre-intervention, $^{*}P < 0.05$.

3.3. Comparison of knee joint function

After intervention, the scores of stiffness, pain, and daily activities in the WOMAC scale of both groups declined, and the herbal friction group had a more significant decrease ($P < 0.05$). See **Table 2**.

Table 2. Comparison of each dimension score of the WOMAC scale ($\overline{x} \pm s$)

Group	Cases	Stiffness		Pain		Daily activities	
		Before	After	Before	After	Before	After
Herbal friction group	20	4.93±1.03	1.23±0.47*	13.87±2.54	3.56±1.24*	40.82±6.52	7.32±2.58*
Conventional group	20	5.06±0.89	2.62±0.68*	14.13±2.36	5.83±1.45*	41.37±6.41	11.62±3.14*
t value	-	0.427	7.520	0.335	5.321	0.269	4.732
P value	-	0.672	< 0.001	0.739	< 0.001	0.789	< 0.001

Note: vs. pre-intervention, $^{*}P < 0.05$.

3.4. Comparison of quality of life

After intervention, the scores of physiological function, emotional function, and social function in the SF-36 scale of both groups increased, and the herbal friction group had higher scores in all dimensions ($P< 0.05$). See **Table 3**.

Table 3. Comparison of each dimension score of the SF-36 scale ($\overline{x} \pm s$)

Group	Cases	Physiological function		Emotional function		Social function	
		Before	After	Before	After	Before	After
Herbal friction group	20	53.86±7.53	83.62±8.47*	51.47±6.86	75.43±7.92*	62.83±7.74	77.56±8.13*
Conventional group	20	54.31±6.89	71.42±7.85*	52.13±6.73	65.32±7.51	63.46±7.62	72.44±7.78*
t value	-	0.197	4.725	0.315	4.143	0.259	4.262
P value	-	0.845	< 0.001	0.754	< 0.001	0.797	< 0.001

Note: vs. pre-intervention, $^{*}P < 0.05$.

4. Discussion

The pathogenesis of KOA is complex, which is related to chronic strain, obesity, physical constitution, and calcium loss. Long-term clinical practice has proved that TCM characteristic therapies show prominent

advantages in the treatment and nursing of KOA. In TCM theory, KOA is categorized as Bi Syndrome or Knee Bi Syndrome. Invasion of wind, cold, and damp pathogens leads to blood stasis: cold causes contraction of joint tissues and results in joint pain and stiffness; accumulated dampness blocks Qi and blood circulation, leading to heavy distending pain of joints [12,13].

In this study, meridian-unblocking herbal friction combined with infrared irradiation was applied to elderly KOA patients. The results showed that the total effective rate of the combined intervention group was significantly higher. Its NRS score, swelling degree, and WOMAC score were lower, while SF-36 scores were higher than those of the conventional group. It indicates that this combined regimen can effectively relieve knee pain and swelling, improve joint function and quality of life, and enhance overall clinical efficacy.

The herbal prescription used in this study has multiple therapeutic effects: *Arnebia euchroma* and *Radix Paeoniae* Rubra clear heat, detoxify, reduce swelling, and activate blood circulation; *Radix Paeoniae* Alba relieves pain; *Salvia miltiorrhiza* exerts anti-inflammatory, analgesic, and blood-activating effects; Dandelion works for detoxification and detumescence; *Angelica Dahurica* dispels cold and alleviates pain; Licorice has detoxification and analgesic effects. After decoction, the medicinal liquid acts directly on the lesions via friction and hot compress, so the active ingredients take effect rapidly to relieve pain, eliminate inflammation, activate blood, and resolve stasis [14]. Meanwhile, infrared irradiation raises local skin temperature, accelerates drug absorption, improves blood circulation of the knee, and reduces the level of local inflammatory factors. The two therapies complement each other. Besides, improved local physical conditions also facilitate early functional training of patients [15]. The combination produces synergistic effects and further improves clinical outcomes, relieving patients' physical discomfort and improving their overall quality of life.

5. Conclusion

In conclusion, nursing intervention combining meridian-unblocking herbal friction with infrared irradiation has a good clinical effect on elderly KOA patients. It can effectively alleviate joint symptoms, restore knee function, and improve patients' quality of life, which is worthy of clinical promotion.

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References

[1] Simental-Mendía M, Ortega-Mata D, Acosta-Olivo C, et al., 2025, Effect of Collagen Supplementation on Knee Osteoarthritis: An Updated Systematic Review and Meta-Analysis of Randomized Controlled Trials. Clinical and Experimental Rheumatology, 43(1): 126–134.

[2] Mahmoudian A, King L, Liew J, et al., 2024, Timing Is Everything: Towards Classification Criteria for Early-Stage Symptomatic Knee Osteoarthritis. Osteoarthritis and Cartilage, 32(6): 649–653.

[3] Lai Q, Li M, Ma J, et al., 2021, Meta-Analysis of Clinical Efficacy and Safety of Acupuncture Combined with Oral Chinese Medicine in the Treatment of Knee Osteoarthritis. Journal of Guangzhou University of Chinese Medicine, 38(12): 2701–2707.

[4] Guo J, Li F, Feng Y, 2022, Attach Importance to TCM Diagnosis and Treatment of Knee Osteoarthritis and Select Non-Pharmacological TCM Therapies Scientifically — Interpretation of Guidelines for the Diagnosis and Treatment of Knee Osteoarthritis (2020 Edition). Chinese Journal of Traditional Medical Traumatology & Orthopedics, 34(4): 1–3.

[5] Simental-Mendía M, Ortega-Mata D, Acosta-Olivo C, et al., 2025, Effect of Collagen Supplementation on Knee Osteoarthritis: An Updated Systematic Review and Meta-Analysis of Randomized Controlled Trials. Clinical and Experimental Rheumatology, 43(1): 126–134.

[6] Li X, 2022, Research Progress of Traditional Chinese Medicine in the Treatment of Knee Osteoarthritis. Chinese Journal of Convalescent Medicine, 31(12): 1266–1269.

[7] Zhao L, Liu H, Chen S, 2023, Application of TCM Directional Drug Penetration Combined with Herbal Fumigation in Patients with Knee Osteoarthritis. Chinese and English Journal of Integrated Traditional Chinese and Western Medicine Nursing, 9(8): 53–56.

[8] Li R, 2023, Application Effect of TCM Bi-Relieving Nursing Combined with Infrared Irradiation in Patients with Knee Osteoarthritis. Medical Equipment, 36(15): 120–122.

[9] Cao K, Guo J, Li F, et al., 2022, Research Status of External Chinese Medicine Therapy for Knee Osteoarthritis. Traditional Chinese Medicine Bulletin, 21(6): 57–60.

[10] Yuan P, 2022, Standardized Application of Proprietary Chinese Medicines in the Treatment of Knee Osteoarthritis — Interpretation of Guidelines for the Diagnosis and Treatment of Knee Osteoarthritis (2020 Edition). Chinese Journal of Traditional Medical Traumatology & Orthopedics, 34(2): 1–2 + 11.

[11] Yeung W, Chen S, Cheung D, et al., 2024, Self-Administered Acupressure for Probable Knee Osteoarthritis in Middle-Aged and Older Adults: A Randomized Clinical Trial. JAMA Network Open, 7(4): e245830.

[12] Ma K, Gou L, Chen L, et al., 2024, Clinical Study on Herbal Fumigation for Wind-Cold-Damp Bi-Type Knee Osteoarthritis Assisted by Infrared Thermography. Clinical Journal of Chinese Medicine, 16(7): 66–71.

[13] Lin F, 2023, Discussion on the Advantages of Traditional Chinese Medicine in Treating Knee Osteoarthritis. Popular Science & Technology, 25(2): 136–139.

[14] Fu X, 2021, Therapeutic Effect of Herbal Hot Compress Combined with Infrared Irradiation on Knee Osteoarthritis. Chinese Journal of Gerontology, 41(16): 3446–3449.

[15] Wang Q, Zhao R, 2014, Clinical Observation of External Application of Huoluo Oil in the Treatment of Knee Arthritis. Chinese Pharmacological Bulletin, 30(12): 1783–1785.

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Innoscience Research covers biology, chemistry, physics and many other disciplines. It mainly focuses on the improvement of human health. It aims to promote the cooperation, exploration and exchange among researchers from different countries. By establishing platforms, Innoscience integrates the demands from different fields to realize the combination of clinical research and basic research and to accelerate and deepen the international scientific cooperation.

Cooperation Mode

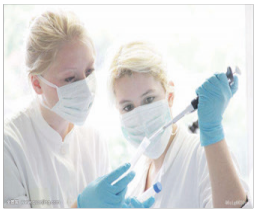


Clinical Workers



In-service Doctors





Foreign Researchers

China Collaborators



Oversea Collaborators



Hospital



University



Scientific institutions

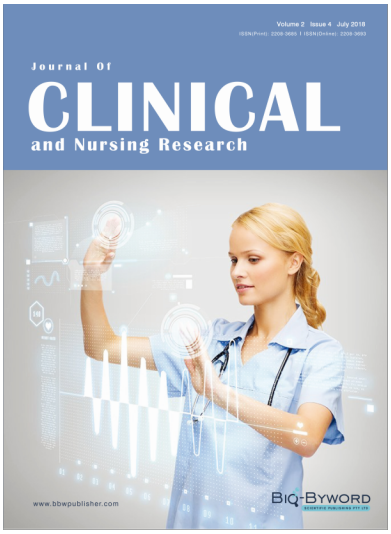
Our Journals



The *Journal of Architectural Research and Development* is an international peer-reviewed and open access journal which is devoted to establish a bridge between theory and practice in the fields of architectural and design research, urban planning and built environment research.

Topics covered but not limited to:

- Architectural design
- Architectural technology, including new technologies and energy saving technologies
- Architectural practice
- Urban planning
- Impacts of architecture on environment



Journal of Clinical and Nursing Research (JCNR) is an international, peer reviewed and open access journal that seeks to promote the development and exchange of knowledge which is directly relevant to all clinical and nursing research and practice. Articles which explore the meaning, prevention, treatment, outcome and impact of a high standard clinical and nursing practice and discipline are encouraged to be submitted as original article, review, case report, short communication and letters.

Topics covered by not limited to:

- Development of clinical and nursing research, evaluation, evidence-based practice and scientific enquiry
- Patients and family experiences of health care
- Clinical and nursing research to enhance patient safety and reduce harm to patients
- Ethics
- Clinical and Nursing history
- Medicine



Journal of Electronic Research and Application is an international, peer-reviewed and open access journal which publishes original articles, reviews, short communications, case studies and letters in the field of electronic research and application.

Topics covered but not limited to:

- Automation
- Circuit Analysis and Application
- Electric and Electronic Measurement Systems
- Electrical Engineering
- Electronic Materials
- Electronics and Communications Engineering
- Power Systems and Power Electronics
- Signal Processing
- Telecommunications Engineering
- Wireless and Mobile Communication